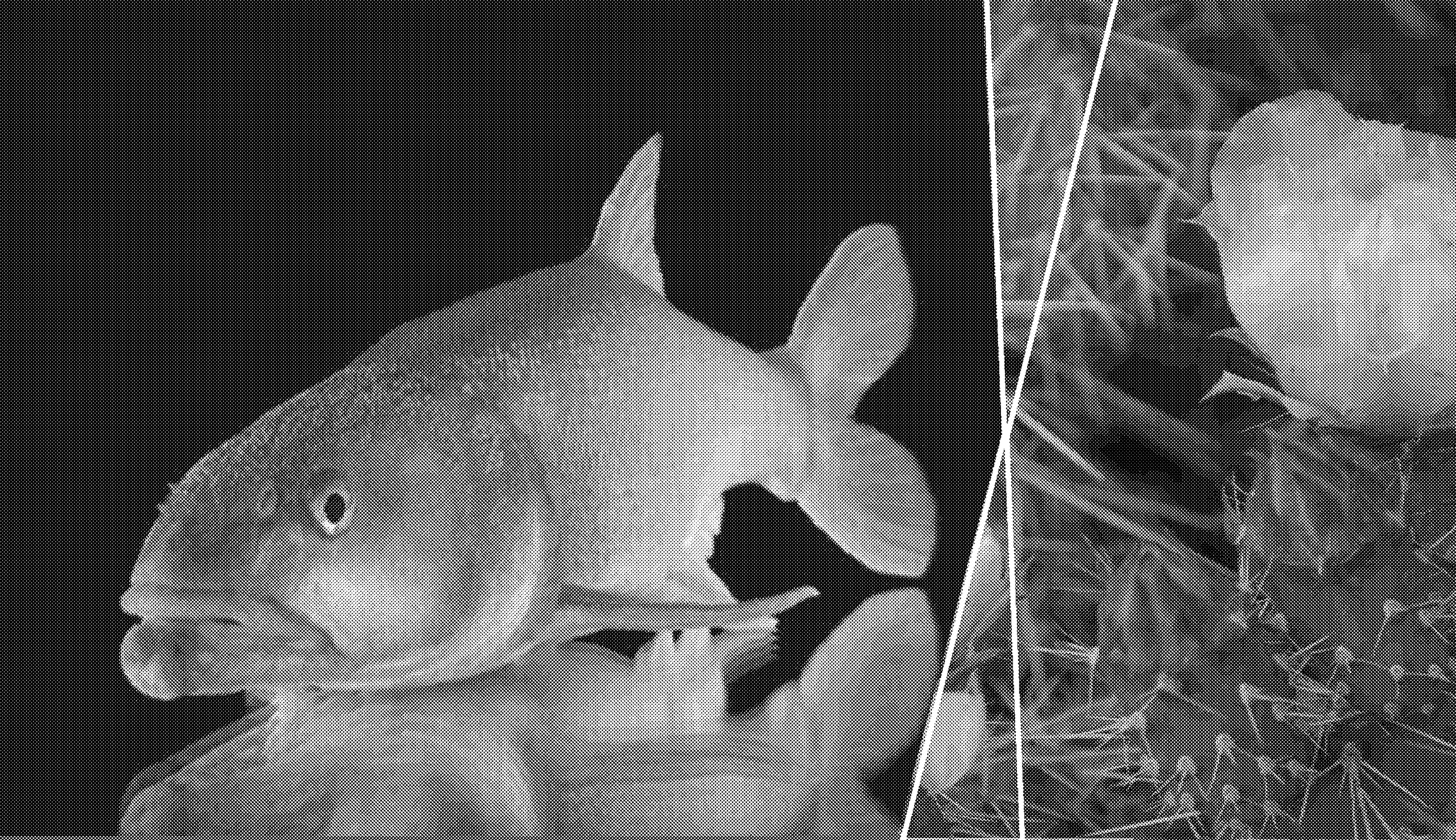

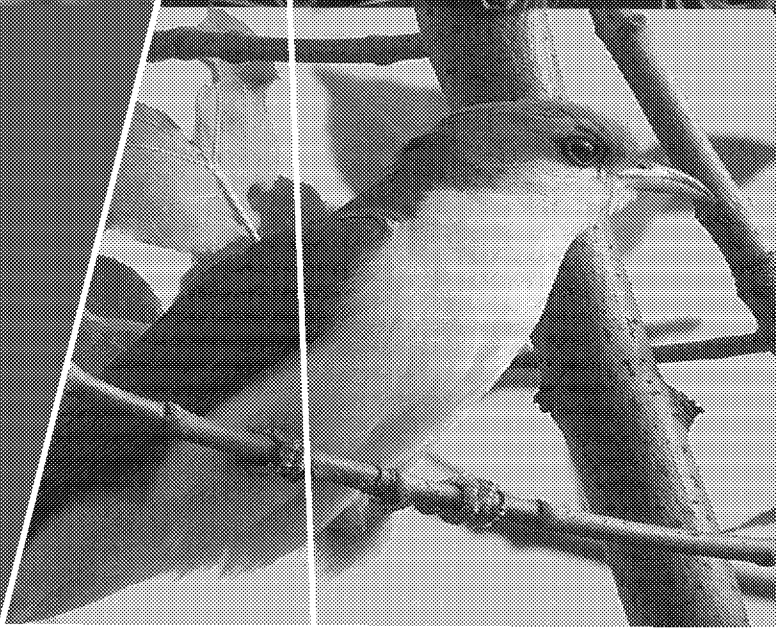

Four Corners Power Plant and Navajo Mine Energy Project

Biological Assessment

OFFICE OF SURFACE MINING RECLAMATION AND ENFORCEMENT

May 2014
Client Review Draft

Document Information

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Cooperating Agencies

Bureau of Indian Affairs (BIA)
Bureau of Land Management (BLM)
Hopi Tribe
Navajo Nation
U.S. Army Corps of Engineers (USACE)
U.S. Environmental Protection Agency (USEPA)
U.S. Fish and Wildlife Service (USFWS)
National Park Service (NPS)

Table of Contents

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Appendices

Tables

Figures

Acronyms

°C	degrees Celsius
°F	degrees Fahrenheit
µg/g DW	microgram(s) per gram on a dry weight
µg/L	microgram(s) per liter
95% UCL	95 percent upper confidence on the mean
af/yr	acre-feet per year
ANFO	ammonium nitrate and fuel oil
AOC	approximate original contour
APLIC	Avian Power Line Interaction Committee
APS	Arizona Public Service Company
BA	Biological Assessment
BAF	bioaccumulation factor
BART	best available retrofit technology
BBNMC	BHP Billiton New Mexico Coal
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BMP	best management practice
BNCC	BHP Navajo Coal Company
BO	Biological Opinion
CBR	critical body residue
CBSG	Conservation Biology Specialist Group
CCR	coal combustion residual
CFR	Code of Federal Regulations
cfs	cubic foot/feet per second
cm	centimeter(s)
COPEC	chemical of potential ecological concern
CPUE	catch per unit effort
DFADA	Dry Fly Ash Disposal Area
DPS	Distinct Population Segment
DSI	dry sorbent injection
EAP	Emergency Action Plan
EIS	Environmental Impact Statement
ELS	early life stage
EPA	United States Environmental Protection Agency

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EPC	exposure point concentration
EPRI	Electric Power Research Institute
ERA	Ecological Risk Assessment
ESA	Endangered Species Act
FCPP	Four Corners Power Plant
FGD	flue gas desulfurization
FIP	Federal Implementation Plan
FR	Federal Register
g	gram(s)
GEM	gaseous elemental mercury
gpm	gallon(s) per minute
H_2SO_4	sulfuric acid
HDPE	high-density polyethylene
Hg	mercury
Hg(p)	particulate mercury
HQ	hazard quotient
IPaC	Information, Planning, and Conservation
kg	kilogram(s)
km	kilometer(s)
kV	kilovolt(s)
LAI	Lined Ash Impoundment
lb/MMBtu	pound(s) per million British thermal units
LDWP	Lined Decant Water Pond
LOAEL	lowest-observable-adverse-effect-level
LOEC	lowest-observable-effect-concentration
MeHg	methylmercury
mg/kg ww	milligram(s) per kilogram wet weight
mg/L	milligram(s) per liter
mL	milliliter(s)
mm	millimeter(s)
MMCo	BHP Billiton Mine Management Company
MSGP	Multi-Sector General Permit
MW	megawatt(s)
MW-hr(s)	megawatt hour(s)
NAPI	Navajo Agricultural Products Industry
NEPA	National Environmental Policy Act of 1969
NESL	Navajo Nation Endangered Species List

NIIP	Navajo Indian Irrigation Project
NNDFW	Navajo Nation Department of Fish and Wildlife
NNEPA	Navajo Nation Environmental Protection Agency
NNHP	Navajo Natural Heritage Program
NOAEL	no-observable-adverse-effect-level
NOEC	no-observable-effect-concentration (NOEC)
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NTEC	Navajo Transitional Energy Corporation
ORV	offroad vehicle
OSMRE	Office of Surface Mining Reclamation and Enforcement
PAHs	polycyclic aromatic hydrocarbons
PATFM	potentially acid- and toxic-forming material
PBM	particle bound mercury
PCEs	primary constituent elements
PM_{10}	respirable particulate matter (particulate matter with an aerodynamic diameter of 10 microns or less)
$PM_{2.5}$	fine particulate matter (particulate matter with an aerodynamic diameter of 2.5 microns or less)
PNM	Public Service Company of New Mexico
ppm	part(s) per million
PSD	Prevention of Significant Determination
PVA	Population Viability Analysis
QA/QC	quality assurance/quality control
Reclamation	U.S. Bureau of Reclamation
RGM	reactive gaseous mercury
RM	River Mile
ROD	Record of Decision
ROW	right-of-way
SCR	selective catalytic reduction
SJRRIP	San Juan River Recovery Implementation Program
SJWWII	San Juan Watershed Woody-Invasives Initiative
SMCRA	Surface Mining Control and Reclamation Act
SO_2	sulfur dioxide
SPCC	Spill Prevention, Containment, and Countermeasure
SWPPP	Stormwater Pollution Prevention Plan

TEL	threshold effects level
TL	total length
TRV	toxicity reference value
USACE	United States Army Corps of Engineers
USC	United States Code
USDI	United States Department of the Interior
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WARMF	Watershed Analysis Risk Management Framework (model)

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Executive Summary

The Office of Surface Mining Regulation and Enforcement (OSMRE) has prepared the attached Biological Assessment to evaluate the effects of the Four Corners Power Plant (FCPP) and Navajo Mine Energy Project on species listed as threatened or endangered and for species that are proposed or candidates for listing under the federal Endangered Species Act (ESA), that are likely to occur within the Action Area.

The purpose of this initiation package is to review the Proposed Action in sufficient detail to determine to what extent the Proposed Action may affect any of the ESA threatened, endangered, proposed or candidate species and designated or proposed critical habitat listed below. In addition, information is provided pursuant to statutory requirements to use the best scientific and commercial information available when assessing the risks posed to these species and habitats by the Proposed Action. This initiation package is prepared in accordance with the legal requirements set forth under regulations implementing ESA Section 7 (50 Code of Federal Regulations 402; 16 United States Code 1536 (c)).

The Proposed Action consists of the issuance of permits by OSMRE and other cooperating agencies including the Bureau of Indian Affairs, U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, and the Bureau of Land Management for continued operation of FCPP, transmission lines, and ancillary facilities for 25 years to 2041, and renewal of the existing Navajo Mine Surface Mining Control and Reclamation Act (SMCRA) permit, and issuance of a new SMCRA for the Pinabete Permit Area to supply coal to FCPP over this period.

The Action Area for the Proposed Action encompasses the lease areas for FCPP, Navajo Mine, the Pinabete Permit Area, and transmission line right-of-ways (ROWs), as well as the Deposition Area for emissions from the FCPP. With the exception of the transmission line ROWs, all of these areas lie within San Juan County, New Mexico. The transmission lines cross portions of San Juan, McKinley, and Sandoval counties, New Mexico, and Apache, Coconino, and Navajo counties, Arizona. The Action Area was extended to include the San Juan River from the upstream extent of the Deposition Area downstream to the San Juan River arm of Lake Powell.

OSMRE obtained a list of species to be considered during this consultation from the Information, Planning, and Conservation (IPaC) system on January 23, 2014. OSMRE obtained this species list under Consultation Tracking Number 02ENNM00-2014-SLI-0064. IPaC was only able to provide a species list for the portions of the Action Area within New Mexico. Per instructions provided by IPaC, species lists for the Arizona counties within which the Action Area lies were obtained from the Arizona USFWS offices website. These lists (provided in Appendix A) identified a total of 39 species that could occur in the 6 counties. Of these, 30 were eliminated from further review because OSMRE concluded that the known distribution of these species does not overlap the Action Area, the Action Area does not support suitable habitat for those species, or the Proposed Action would have no effect on these species, as documented in Appendix B. The nine remaining species are:

- Colorado pikeminnow (*Ptychocheilus lucius*) – Endangered, experimental population
- Razorback sucker (*Xyrauchen texanus*) - Endangered
- Southwestern willow Flycatcher (*Empidonax traillii extimus*) - Endangered
- Yellow-billed cuckoo (*Coccyzus americanus*) - Proposed Threatened
- California condor (*Gymnogyps californianus*) – Endangered, experimental population
- Mexican spotted owl (*Strix occidentalis lucida*) - Threatened
- Mancos milk-vetch (*Astragalus humillimus*) - Endangered

- Mesa Verde cactus (*Sclerocactus mesae-verdae*) – Threatened
- Fickeisen plains cactus (*Pediocactus peeblesianus* var. *fickeiseniae*) - Endangered

Critical habitat occurs within the Action Area for Colorado pikeminnow, razorback sucker, and Fickeisen plains cactus.

OSMRE evaluated the potential effects of the Proposed Action on these species and critical habitat. OSMRE's determinations are summarized below.

Effects on Species

- The Proposed Action, in combination with baseline conditions and reasonably foreseeable future conditions, may affect and is likely to adversely affect Colorado pikeminnow, as a result of entrainment at the Arizona Public Service Company (APS) Weir, release of non-native fish from Morgan Lake into the San Juan River via No Name Wash and the Chaco River, and atmospheric emissions of contaminants that are already present in watershed in quantities that may adversely affect the species.
- The Proposed Action, in combination with baseline conditions and reasonably foreseeable future conditions, may affect and is likely to adversely affect razorback sucker, as a result of entrainment at the APS Weir, release of non-native fish from Morgan Lake into the San Juan River via No Name Wash and the Chaco River, and atmospheric emissions of contaminants that are already present in the watershed in quantities that may adversely affect the species.
- The Proposed Action, in combination with baseline conditions and reasonably foreseeable future conditions, may affect but is not likely to adversely affect southwest willow flycatcher under current conditions. In the event that nesting of this species occurs in the Action Area over the life the Proposed Action, as a result of ongoing riparian habitat restoration efforts, the Proposed Action may affect and is likely to adversely affect southwestern willow flycatcher.
- The Proposed Action, in combination with baseline conditions and reasonably foreseeable future conditions, may affect but is not likely to adversely affect yellow-billed cuckoo under current conditions. In the event that nesting of this species occurs in the Action Area over the life the Proposed Action, as a result of ongoing riparian habitat restoration efforts, the Proposed Action may affect and is likely to adversely affect yellow-billed cuckoo.
- The Proposed Action, in combination with baseline conditions and reasonably foreseeable future conditions, may affect, but is not likely to adversely affect, California condor.
- The Proposed Action, in combination with baseline conditions and reasonably foreseeable future conditions, may affect, but is not likely to adversely affect, Mexican spotted owl.
- The Proposed Action, in combination with baseline conditions and reasonably foreseeable future conditions, may affect, but is not likely to adversely affect, Mancos milk-vetch.
- The Proposed Action, in combination with baseline conditions and reasonably foreseeable future conditions, may affect, but is not likely to adversely affect, Mesa Verde cactus.
- The Proposed Action, in combination with baseline conditions and reasonably foreseeable future conditions, may affect, but is not likely to adversely affect, Fickeisen plains cactus.

Effects on Designated Critical Habitat

- The Proposed Action may adversely modify critical habitat for Colorado pikeminnow, through release of non-native fish from Morgan Lake into designated critical habitat for these species. The ongoing operation of APS Weir, which lies within critical habitat for Colorado pikeminnow, would continue to impair passage for this species.
- The Proposed Action may adversely modify critical habitat for razorback sucker, through release of non-native fish from Morgan Lake into designated critical habitat for these species. The APS Weir lies upstream of critical habitat for razorback sucker and, therefore, would not adversely modify critical habitat for this species.
- The Proposed Action is not likely to adversely modify habitat southwest willow flycatcher as designated critical habitat does not occur in the Action Area.
- The Proposed Action is not likely to adversely modify habitat for yellow-billed cuckoo, as critical habitat has not been designated for this species.
- Critical habitat has been designated for California condor, but does not occur within the Action Area. Therefore, no effect on critical habitat would occur for this species.
- Critical habitat has been designated for Mexican spotted owl, but does not occur within the Action Area. Therefore, no effect on critical habitat would occur for this species.
- Critical habitat has not been designated for Mancos milk-vetch. Therefore, no effect on critical habitat would occur.
- Critical habitat has not been designated for Mesa Verde cactus. Therefore, no effect on critical habitat would occur.
- The Proposed Action would not adversely modify critical habitat for Fickeisen plains cactus.

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1 Introduction

1.1 Background

This Biological Assessment (BA) is prepared in accordance with the requirements of the federal Endangered Species Act (ESA) and analyzes the effects of numerous federal actions relating to the Proposed Action defined herein. The project that comprises the Proposed Action is referred to as the Four Corners Power Plant and Navajo Mine Energy Project (Project), which generally involves federal approvals related to the continued operation of the Four Corners Power Plant (FCPP) for 25 years commencing in 2016, the continued mining at Navajo Mine to provide a coal supply to future FCPP operations, and issuance or renewal of right-of-ways (ROWs) for several transmission lines and roads associated with the operations of the FCPP and Navajo Mine.

The Office of Surface Mining, Reclamation and Enforcement (OSMRE) serves as the Lead Agency for Section 7 consultation and compliance for the Proposed Action, as described below. These actions required the approval of several other federal Cooperating Agencies including the Bureau of Indian Affairs (BIA), U.S. Environmental Protection Agency (EPA), U.S. Army Corps of Engineers (USACE), and Bureau of Land Management (BLM).

The Project Proponents are the Arizona Public Service Company (APS), which is part owner of FCPP and represents the ownership of FCPP in this action. APS also owns and operates two of the transmission lines being considered as part of the action. Navajo Transitional Energy Corporation (NTEC) owns and operates Navajo Mine and the Pinabete Permit Area and is responsible for all mining operations. Public Service Company of New Mexico (PNM) is part owner of the FCPP and owns and operates two of the transmission lines being considered as part of the action.

The ESA requires federal agencies to ensure that all actions that they authorize, fund, or carry out are not likely to jeopardize the continued existence of any endangered or threatened species, or result in the destruction or adverse modification of their critical habitat. The federal agency is required to consult with the U.S. Fish and Wildlife Service (USFWS) and/or National Marine Fisheries Service on any activities they undertake that have the potential to affect species listed under the ESA. This BA evaluates the direct and indirect effects of the Proposed Action to ESA listed threatened, endangered species, as well as species proposed for listing, and their critical habitats that lie within the Action Area, as described in Section 2.4. Relevant candidate species are not required to be evaluated under the ESA, but OSMRE has evaluated potential impacts to candidate species where they are potentially affected by the Proposed Action. The BA also evaluates the effects of actions or activities that are interrelated and interdependent with the Proposed Action and cumulative effects on these species, in the Action Area.

The specific federal actions included in the effects analysis of this BA are as follows:

Navajo Mine

1. OSMRE approval of Navajo Mine's application for a new Surface Mining Control and Reclamation Act (SMCRA) permit for the Pinabete Permit Area, which is located within the existing Navajo Mine Lease Area, to begin operations in 2016 and continue through 2041 in 5-year permit renewal intervals
2. OSMRE renewal of Navajo Mine's existing SMCRA permit NM-0003F for Areas I, II, III, and portions of Area IV North of the Navajo Mine Lease Area for 5 years beginning in 2014
3. BIA approval of ROW renewals for a 0.86-mile mining road, which provides access in Area III, a 1.32-mile Access Road/Power and Communication lines from the FCPP site to Navajo Mine coal

lease, and a 6.6-mile access road from the bridge at the San Juan River near the Nahnanezad School to the FCPP site

4. BLM approval of the revised Mine Plan for the purposed maximum economic recovery of coal reserved
5. USACE approval of Navajo Mine's permit application for a Section 404 Individual Permit for impacts to jurisdictional Waters of the U.S. under the Clean Water Act
6. EPA approval of the permit application for a new source Section 402 National Pollutant Discharge Elimination System (NPDES) Industrial Permit
7. Navajo Nation Environmental Protection Agency (NNEPA) approval of the permit application for a Section 401 water quality certification

Four Corners Power Plant

1. BIA approval of APS FCPP lease amendment and ROW renewals, located on the Navajo Nation in San Juan County, New Mexico, for 25 years beginning in 2016
2. BIA approval of ROW renewals for four transmission lines associated with the FCPP
3. BLM approval of ROW renewals for four transmission lines associated with the FCPP

The listed federal actions are collectively referred to as the "Proposed Action."

OSMRE and the cooperating agencies are also preparing an Environmental Impact Statement (EIS) for the Proposed Action (OSMRE 2014) in accordance with the National Environmental Policy Act of 1969 (NEPA) as amended, 42 United States Code (USC) 4321–4347; the Council on Environmental Quality's regulations for implementing NEPA, 40 Code of Federal Regulations (CFR) Parts 1500 through 1508; and the U.S. Department of the Interior's (USDI's) NEPA regulations, 43 CFR Part 46.

The development of the Proposed Action occurred contemporaneously with EPA's issuance of its source-specific Federal Implementation Plan (FIP) for its Best Available Retrofit Technology (BART) to achieve emissions reductions required by the Clean Air Act (40 CFR 49.5512). EPA has required FCPP to reduce nitrogen oxide (NO_x) emissions. EPA has also set particulate matter emission limits, based on emission rates already achieved at FCPP, which contributes to visibility impairment in 16 mandatory Class I federal areas around FCPP.

The final FIP allows APS to choose between two BART options:

- Shut down Units 1, 2, and 3 by January 1, 2014, and install and operate Selective Catalytic Reduction (SCR) devices on Units 4 and 5 to comply with a BART emission limit of 0.098 pound of NO_x per million British thermal units of heat input (lb/MMBtu) on Units 4 and 5 by July 31, 2018; or
- Retrofit all five units to comply with a plantwide BART emission limit of 0.11 lb/MMBtu of NO_x by installing and operating an SCR device on one 750-megawatt (MW) unit by October 23, 2016, and installing and operating SCR control technology on the remaining four units by October 23, 2017.

The FIP for BART at FCPP required APS to notify EPA of its choice of BART compliance option by July 1, 2013. EPA subsequently extended the date by which APS must notify EPA of its BART compliance strategy from July 1, 2013, to December 31, 2013.

APS notified EPA of its selection of the first option and shut down Units 1, 2, and 3 on December 30, 2013. This shutdown resulted in substantial reductions in emissions from FCPP beginning the first day, as documented in Section 2.5.2.2.1. Because the EPA's action predates the initiation of this Section 7 consultation, the shutdown of Units 1, 2, and 3 and SCR installation on Units 4 and 5 are considered part of the baseline in this analysis. The benefits of this action are, however, recognized throughout this BA.

This BA analyzes the Proposed Action to determine whether implementation of the Proposed Action would affect any species that are listed under the ESA, their critical habitats, or any species proposed for listing and, if so, the level of such an effect. As required by the ESA, one of three possible determinations will be chosen for listed species based on the best available scientific and commercial data, a thorough analysis of the Project's potential effects, and the professional judgment of the wildlife and fisheries biologists and ecologists who completed the evaluation. The three possible determinations are as follows:

- "*No effect*" – where no effect is expected.
- "*May affect, not likely to adversely affect*" – where effects are expected to be beneficial, insignificant (immeasurable), or discountable (extremely unlikely).
- "*May affect, likely to adversely affect*" – where effects are expected to be adverse or detrimental. In the event that the overall effect of a proposed action is beneficial to the listed species, but also is likely to cause some adverse effects, a proposed action is likely to adversely affect the listed species. This determination requires formal Section 7 consultation.

In assessing the effects of the Proposed Action on designated critical habitat as required by the ESA, the BA assesses whether the Proposed Action is likely to result in the destruction or adverse modification of critical habitat, with four possible determinations. If critical habitat has not been designated for a species, then the appropriate determination is:

- No critical habitat has been designated for this species; therefore, none will be destroyed or adversely modified.

If critical habitat has been designated, then three possible determinations are:

- Critical habitat has been designated for this species, but the action is not likely to affect that critical habitat. Therefore, no destruction or adverse modification of the critical habitat is likely to occur.
- The action is likely to result in the destruction or adverse modification of critical habitat.
- The action is not likely to result in the destruction or adverse modification of critical habitat.

1.2 Consultation History

OSMRE and USFWS have been engaged in informal technical assistance since May 23, 2012. Since this time, OSMRE, USFWS, and the Project Proponents have discussed numerous issues relating to the Proposed Action and its potential effects on listed species in the Action Area. These communications are described briefly below.

- **May 23, 2012.** Cooperating Agency Kickoff Meeting to discuss the Project and potential environmental issues. Attended by OSMRE, Cooperating Agencies, Project Proponents, USFWS, and Cardno.
- **June 28, 2012.** OSMRE and USFWS meeting in Albuquerque to discuss Section 7 consultation and initiate technical assistance for the Project. Attended by OSMRE and USFWS.
- **July 19, 2012.** Section 7 Coordination Meeting, Farmington. Discussion topics included air and ecological risk models, species lists, and Section 7/NEPA coordination. Attended by OSMRE, USFWS, BIA, EPA, APS, BHP Navajo Coal Company (BNCC), PNM, Conservation Biology Specialist Group (CBSG), Cardno, AECOM, Electric Power Research Institute (EPRI), and Salt River Project.
- **August 21, 2012**. Section 7 Working Group Conference call. Topics included EPRI and AECOM data collection and modeling schedules, Preliminary Draft EIS schedule and review process, request by USFWS to add Population Viability Analysis (PVA) to the modeling efforts, BA

schedule. Attended by OSMRE, USFWS, BIA, USACE, Navajo Nation, APS, BNCC, PNM, CBSG, Cardno, and AECOM.

- **October 19, 2012.** Call to discuss PVA model. Attended by OSMRE, USFWS, USACE, BIA, APS, BNCC, PNM, CBSG, Cardno, and AECOM.
- **November 26, 2012.** Call to discuss Ecological Risk Assessments (ERA) and supporting studies. Attended by OSMRE, USFWS, APS, BNCC, Cardno, AECOM, and ERM.
- **February 13, 2013.** Call to discuss technical memos addressing the Proponent's ERA reports; specifically, the Proposed Wildlife Exposure Parameters, the Listed Species Spreadsheet, and the Draft Habitat Model Report. Attended by OSMRE, BIA, USFWS, APS, BNCC, PNM, AECOM, and Cardno.
- **February 25, 2013.** The call was initiated to discuss the scope of work and schedule for the Conservation Breeding Specialist Group PVA. Attended by OSMRE, BIA, USFWS, APS, BNCC, PNM, CBSG, and Cardno.
- **February 28, 2013.** The meeting of the ESA Section 7 Working Group was initiated to provide an update on status of studies in progress and an opportunity for input from Working Group members to complete data gaps before the coming Preliminary Draft EIS and Biological Assessment. Attended by OSMRE, USDI's Office of the Solicitor, BIA, USFWS, Navajo Nation, USACE, National Park Service (NPS), APS, BNCC, PNM, AECOM, Cardno, EPRI, ERM, Environ, and Systech Water Resources, Inc.
- **April 25, 2013.** A call was held to conduct deliberative discussion and coordination to ensure that the information provided by APS/AECOM is adequate for preparation of the ERA. Attended by OSMRE, USFWS, and Cardno.
- **May 22, 2013.** The meeting was requested by the Project Proponents to give EPRI and Systech an opportunity to discuss initial results as they relate to USFWS' comment regarding a significant deficiency in the food-web model and to establish a path forward to address USFWS' comments. Attended by OSMRE, BIA, USFWS, APS, BNCC, PNM, AECOM, Cardno, EPRI, Environ, and Systech Water Resources, Inc.
- **August 6-7, 2013**. PVA Workshop. Discussion of scope and setup of PVA model. Attended by CBSG, APS, BNCC, USFWS, Miller Ecological Consulting, and Cardno.
- **August 8, 2013.** The meeting of the Four Corners Power Plant and Navajo Mine Energy Project ESA Section 7 Working Group was held to provide an update on the PVA initiative, give EPRI an opportunity to present methodologies and preliminary results of their modeling efforts, and give AECOM an opportunity to describe the draft ERA report. Attended by OSMRE, USDI's Office of the Solicitor, BIA, USFWS, EPA, USACE, Bureau of Reclamation (Reclamation), Navajo Nation, Hopi Tribe, APS, BNCC, PNM, AECOM, Systech Water Resources, NPS, EPRI, ERM, Environ, and Cardno.
- **August 23, 2013.** The meeting was initiated to allow enhanced coordination during the Four Corners Power Plant and Navajo Mine Energy Project EIS Section 7 consultation process. The Proponents requested more cooperative dialogue in the consultation process. Attended by OSMRE, BIA, USFWS, APS, BNCC, PNM, AECOM, Environ, EPRI, and Cardno.
- **September 11, 2013.** The recurring monthly Section 7 consultation coordination meeting allows enhanced coordination during the Four Corners Power Plant and Navajo Mine Energy Project EIS Section 7 consultation process. Attended by OSMRE, BIA, USFWS, APS, AECOM, BNCC, PNM, EPRI, and Cardno.

- **November 13, 2013.** The recurring monthly Section 7 consultation meeting allows enhanced coordination during the Four Corners Power Plant and Navajo Mine Energy Project EIS Section 7 consultation process. Attended by OSMRE, BIA, USFWS, APS, AECOM, BNCC, PNM, Cardno, EPRI, and Systec Water Resources.
- **November 13, 2013.** OSMRE submitted a letter to Mr. David Campbell of the USFWS requesting confirmation of species to be included in the consultation. Mr. Campbell confirmed the list via email on December 16, 2013.
- **December 11, 2013.** The recurring monthly Section 7 consultation meeting allows enhanced coordination during the Four Corners Power Plant and Navajo Mine Energy Project EIS Section 7 consultation process. Attended by OSMRE, BIA, USFWS, APS, Latham and Watkins (APS Counsel), AECOM, BNCC, PNM, EPRI, and Cardno.
- **December 17-18, 2013.** PVA Workshop 2. Ongoing development of PVA model. Attended by BNCC, APS, USFWS, OSMRE/Cardno, CBSG, SWCA, Miller Ecological Consultants, and ERM.
- **January 16, 2014.** The teleconference was initiated to conduct deliberative discussion on deciding the course of action related to the Prevention of Significant Determination (PSD) permitting consultations. OSMRE had early discussions with EPA to determine if OSMRE should include the PSD permitting action under the EIS Section 7 consultations. Attended by OSMRE, USDI's Office of the Solicitor, USFWS, BIA, and Cardno.
- **January 23, 2014.** Mr. Marcelo Calle of OSMRE and Mr. Larry Wise of Cardno ENTRIX spoke with Mr. Campbell about receiving a formal letter confirming the species list. Mr. Campbell indicated that the USFWS no longer issued these letters, but that they were issued through the Information, Planning, and Conservation (IPaC) system available at the USFWS website.
- **January 23, 2014.** Consultation Tracking Number 02ENNM00-2014-SLI-0064 was assigned by the IPaC system.
- **February 5, 2014.** PVA Coordination Call. Continuing development of PVA model. Attended by OSMRE, USFWS, CBSG; APS, BHP Billiton Mine Management Company (MMCo), Miller Ecological Consulting, Inc., SWCA, ERM, Modrall Sperling Law Firm, Cardno-ENTRIX: Larry Wise, OSMRE: Alex Birchfield
- **March 12, 2014.** The recurring monthly Section 7 consultation meeting allows enhanced coordination during the Four Corners Power Plant and Navajo Mine Energy Project EIS consultation process. Attended by OSMRE, BIA, USFWS, APS, Latham and Watkins (APS Counsel), AECOM, NTEC, MMCo, PNM, EPRI, and Cardno.
- **March 13, 2014.** The call was held to discuss the Project Proponents viewpoint that the shutdown of Units 1, 2, and 3 should not be included in the Project baseline in the Draft BA in the same manner that it is in the Draft EIS. Attended by OSMRE, USDI's Office of Solicitors, APS, MMCo, USFWS, and Cardno.
- **March 18-19, 2014.** PVA Working Group Meeting. Continuing development of PVA model. Attended by OSMRE, USFWS, CBSG, APS, MMCo, Miller Ecological Consulting, Inc., SWCA, ERM, Modrall Sperling Law Firm, Cardno-ENTRIX: Larry Wise, OSMRE: Alex Birchfield
- **April 9, 2014.** The recurring monthly Section 7 consultation meeting allows enhanced coordination during the Four Corners Power Plant and Navajo Mine Energy Project EIS consultation process. Attended by OSMRE, BIA, USFWS, APS, Latham and Watkins (APS Counsel), AECOM, NTEC, EPRI, PNM, MMCo, and Cardno.

- **April 9, 2014.** PVA Model Development Conference Call. Attended by OSMRE, USFWS, MMCo, APS, CBSG, EPRI, ERM, MEC, SWCA, Cardno
- **April 15-16, 2014.** PVA Working Group Meeting. Continuing development of PVA model. Attended by OSMRE, USFWS, CBSG, APS, MMCo, Miller Ecological Consulting, Inc., SWCA, ERM, Modrall Sperling Law Firm, Cardno-ENTRIX: Larry Wise, OSMRE: Alex Birchfield
- **April 21, 2014.** Section 7 Call to discuss schedule. OSMRE, USFWS, Environ Corp, Cardno.

A number of communications occurred among OSMRE, EPA, USFWS and the Proponents relating to how the Section 7 consultation on the PSD permit would be handled. The PSD permit is required because of the EPA's BART FIP, which required FCPP to reduce its atmospheric emissions of NO_X. The technology to comply with this ruling required SCR installation, with subsequent sulfate emissions that exceed EPA thresholds, thus requiring a permit. As a result of these discussions. it was confirmed that the EPA would complete the Section 7 consultation on the PSD permit. Communications surrounding this issue are described below:

- **January 22, 2013.** A call was held to discuss the particular action of installing SCR in compliance with BART. Attended by OSMRE, BIA, EPA, USFWS, APS, BNCC, and Cardno.
- **May 6, 2013.** A call was held to discuss the APS approach to the FCPP PSD permit application, including how the permit application Section 7 consultation should be coordinated with the Four Corners Power Plant and Navajo Mine EIS and associated Section 7 consultation. Attended by OSMRE, APS, Latham and Watkins, BNCC, BIA, and Cardno.
- **December 9, 2013.** The conference call was initiated to discuss Section 7 and Section 106 consultations related to the FCPP PSD permit APS submitted to EPA for review. Attended by OSMRE, BIA, APS, Latham and Watkins (APS Counsel), BNCC, and Cardno.
- **January 6, 2014.** A call was held to conduct deliberative discussion regarding the Project Proponents' desire to have EPA and OSMRE Section 7 and Section 106 consultations related to EPA's PSD permitting action combined. Attended by OSMRE, USDI's Office of the Solicitor, BIA, and Cardno.
- **February 7, 2014.** The call was initiated to continue previous discussions on Section 7 and Section 106 consultations related to EPA's PSD permitting action, specifically to discuss the OSMRE/Cardno January 17, 2014, Technical Memorandum addressing the "pros and cons" of OSMRE and EPA conducting joint or separate consultations. Attended by OSMRE, USDI's Office of the Solicitor, APS, MMCo, BHP, and Cardno.
- **February 11, 2014.** The teleconference was initiated to conduct deliberative discussion on a final position adopted by the Project Proponents regarding the PSD permitting consultations course of action. Attended by OSMRE, USDI's Office of the Solicitor, BIA, and Cardno.

1.3 Species and Designated Critical Habitat

OSMRE obtained a list of species to be considered during this consultation from IPaC on January 23, 2014. OSMRE obtained this species list under Consultation Tracking Number 02ENNM00-2014-SLI-0064. IPaC was only able to provide a species list for the portions of the Action Area within New Mexico. Per instructions provided by IPaC, species lists for the Arizona counties within which the Action Area lies were obtained from the Arizona USFWS offices website (www.fws.gov/southwest/es/endangeredspecies/lists/). These documents are provided in Appendix A. The result was a total of 39 species with the potential to occur within the Action Area. OSMRE reviewed this list, potential Project effects in different portions of the Action Area, and the distribution and habitat requirements of the listed species and determined that the Project has the potential to affect nine species:

- Colorado pikeminnow (*Ptychocheilus lucius*) - Endangered
- Razorback sucker (*Xyrauchen texanus*) - Endangered
- Southwestern willow Flycatcher (*Empidonax traillii extimus*) - Endangered
- Yellow-billed cuckoo (*Coccyzus americanus*) - Proposed Threatened
- California condor (*Gymnogyps californianus*) – Endangered, experimental population
- Mexican spotted owl (*Strix occidentalis lucida*) - Threatened
- Mancos milk-vetch (*Astragalus humillimus*) - Endangered
- Mesa Verde cactus (*Sclerocactus mesae-verdae*) – Threatened
- Fickeisen plains cactus (*Pediocactus peeblesianus* var. *fickeiseniae*) - Endangered

No effect would occur to the other 30 species because the known distribution of these species does not overlap the Action Area, the Action Area does not support suitable habitat for those species, or the Proposed Action would have no effect on these species. Justification for exclusion of these species from the consultation is provided in Appendix B.

Designated critical habitat for Colorado pikeminnow, razorback sucker, and Fickeisen plains cactus occurs within the Action Area. Critical habitat has been designated for southwestern willow flycatcher, California condor, and Mexican spotted owl, but does not lie within the Action Area. Critical habitat has not been designated for yellow-billed cuckoo, Mancos milk-vetch, or Mesa Verde cactus. The effects of the Proposed Action on the critical habitat within the Action Area is evaluated in the BA.

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2 Description of the Proposed Action

2.1 Overview of the Proposed Action

This BA analyzes the potential effects to sensitive species of the Proposed Action, which consists of the continued operation of the FCPP, transmission lines, and ancillary facilities, and Navajo Mine after July 6, 2016, including all necessary actions taken prior to that date to effectuate FCPP operations for a 25-year period into 2041. The FCPP and Navajo Mine are located on the Navajo Nation in New Mexico. The transmission lines all originate from the FCPP and cross the Navajo Nation; certain transmission lines also cross the Hopi Reservation, the Zia Pueblo, BLM, Petroglyph National Monument, New Mexico State Land Office, and private lands.

2.2 Four Corners Power Plant

The Navajo Nation initially granted a lease for the FCPP in 1966, and granted ROWs for the plant site and various transmission lines and related facilities. The Proposed Action consists of continuing to operate the FCPP, transmission lines, and ancillary facilities after July 6, 2016, for the new term of Lease Amendment No. 3 (25 years). The operations conducted during the next lease term will be significantly altered from the operating conditions at the FCPP when APS and the Navajo Nation executed Lease Amendment No. 3 on March 7, 2011, and forwarded it to the BIA for federal approval on July 21, 2011. At that time, the FCPP was operating five existing units to generate approximately 2,100 MW of baseload power. To continue to operate after 2016 in accordance with federal regulations, APS took (and will take) a number of necessary steps to make future operation viable over the next 25 years.

On August 6, 2012, EPA issued a source specific FIP requiring FCPP to achieve air emissions reductions under the Clean Air Act's BART provisions. EPA's BART Rule established two alternative compliance options. APS could retrofit all five units at FCPP to meet certain emission limits (Option 1) or, under an alternative plan proposed by APS, it could install SCR controls on Units 4 and 5 by mid-2018 and retire Units 1, 2, and 3 by January 1, 2014 (Option 2). APS chose Option 2 and shut down Units 1, 2, and 3 on December 30, 2013. Therefore, the Proposed Action is post-2016 operations with Units 1, 2, and 3 retired and requiring SCR controls on Units 4 and 5 in 2018. As noted previously in this BA, because Units 1, 2, and 3 were retired pursuant to EPA's federal action and prior to initiation of formal consultation with regard to the Proposed Action, the effects of the retirement are analyzed as part of the Environmental Baseline for purposes of this BA.

The shutdown of Units 1, 2, and 3 substantially reduced coal consumption and air emissions from historic amounts, and lowered the power output of the plant from 2,100 to 1,540 MW.

EPA's pending coal combustion residual (CCR) rule will govern the future management of CCRs at FCPP. EPA is currently considering whether to manage CCRs as either a Subtitle C hazardous waste or a Subtitle D solid waste. FCPP will comply with applicable EPA rules for the management of CCRs irrespective of what option is selected. The Dry Fly Ash Disposal Area (DFADA) within the existing FCPP Lease Area will increase in size as described in Section 2.5.2.5.2.

No substantial changes are planned for the three existing APS transmission lines that are part of the Proposed Action through 2041 (the FCPP to Moenkopi 500-kilovolt (kV) line and the FCPP to Cholla 345-kV lines) or for the two PNM transmission lines that are part of the Proposed Action (FCPP to West Mesa 345-kV line and the FCPP to San Juan 345-kV line). These lines will continue to be maintained and repaired, as required. No new roads or access routes are anticipated at this time.

The size of the leased acreage footprint of the FCPP and associated ancillary facilities, and transmission lines and associated ancillary facilities would not change. Other than routine maintenance and repair, no changes or modifications are anticipated for the transmission lines, the three FCPP switchyards, Moenkopi Substation, 12-kV line, or access road to ensure continued operation through 2041.

2.3 Navajo Mine

The Navajo Nation granted a 24,000-acre coal lease in July 1957 to Utah Construction and Mining Company. Through a series of subsequent lease revisions and amendments, the lease area, referred to as the Navajo Mine lease, was increased to approximately 33,600 acres. On December 30, 2013, the Navajo Transitional Energy Corporation (NTEC), a Navajo Nation owned Limited Liability Company, became the owner of Navajo Mine (formerly owned by BNCC) and now holds the Navajo Mine lease and the lease surface and mineral rights.

At the same time, BHP Billiton Mine Management Company (MMCo) entered into a Mine Management Agreement with NTEC to continue as operator and manager of the Navajo Mine through 2016. As operator of the mine, and on behalf of NTEC as the SMCRA permittee, MMCo will conduct surface mining and reclamation on the Navajo Mine lease as approved in SMCRA Permit No. NM-0003F and in future revisions or renewals effective during the agreement's term.

Navajo Mine will continue to be the sole supplier of coal to FCPP to support post-2016 operations. For that purpose, NTEC is working with MMCo for OSMRE approval to renew the Navajo Mine SMCRA Permit NM-0003F, effective September 2014, for continued access to coal reserves and to permit the Pinabete Permit Area, a new approximately 5,568-acre surface mine area within Area 4 North and Area 4 South of the Navajo Mine Lease Area. Development of coal reserves in the existing Navajo Mine and proposed Pinabete Permit areas would supply low-sulfur coal to FCPP for up to 25 years beginning July 2016 at a rate of approximately 5.8 million tons per year (a reduction from the pre-2016 production rate of approximately 8 million tons per year).

Within the new proposed Pinabete Permit Area, approximately 4,100 acres would be disturbed from surface mining, construction of haul roads (approximately 5.2 miles), light vehicle roads (approximately 20.8 miles), power lines (approximately 7.7 miles), and construction of related infrastructure such as sediment and drainage control ponds, arroyo crossings, and soil and coal stockpiles (approximately 278 acres). Approximately 2.8 miles of Burnham Road, a public access road, will be realigned as planned mining activities approach the road segment, expected to occur in 2022.

Coal extraction, coal haulage, coal processing (crushing), road and infrastructure construction, and site reclamation techniques would be the same as those currently applied at Navajo Mine. Coal would be extracted utilizing draglines, trucks, and loaders. Mined coal would be transported to existing coal stockpiles using haul trucks, then loaded onto an existing rail transport system and delivered to the on-site coal preparation plant. The coal preparation plant is a stacking and reclaiming facility and not a coal cleaning operation. Water usage at the coal preparation plant is primarily limited to dust suppressant spray and equipment washdown. Surface-water runoff is collected in sediment basins and allowed to evaporate.

Land and prominent drainage features disturbed by mining and related operations would be reclaimed and restored to their approximate pre-mining conditions in a manner compatible with the designated post-mining land use of livestock grazing and wildlife habitat. Successful reclamation of mined lands would be guaranteed by a surety bond that can only be released after OSMRE determines reclamation areas meet approved performance standards.

MMCo would obtain Clean Water Act permits to manage surface-water discharge (e.g., an individual NPDES or a NPDES Multi-Sector General Permit (MSGP) permit) and to fill 5 acres of jurisdictional Waters of the U.S. (Section 404 Individual Permit) for proposed impacts to them in the Pinabete Permit Area. To offset the impacts to Waters of the U.S. and the temporal loss of their functionality during mining and reclamation activities, MMCo would complete compensatory mitigation as part of the Clean Water Act

Section 404 Individual Permit process. Mitigation efforts would be coordinated with the USACE during this permitting process.

In 1958, the State of New Mexico granted Utah International, the predecessor in interest to, BHP Billiton New Mexico Coal Inc. (BBNMC), a permit (New Mexico Office of the State Engineer Permit No. 2838 ["Permit 2838"]) for consumptive use (39,000 acre-feet per year [af/yr]) and diversion (51,600 af/yr) of surface water from the San Juan River. Permit 2838 has provided and will continue to provide all the necessary water supply to support operations at FCPP and Navajo Mine including all water use associated with the Proposed Action.

Between 1971 and January 2008, CCRs from FCPP were used as mine backfill material in mined-out pits or ramps in Areas 1 and 2 at Navajo Mine. The historical CCR placement at Navajo Mine was conducted in accordance with the Navajo Mine lease and OSMRE SMCRA Permit NM-0003F. CCRs are currently classified by the EPA as nonhazardous waste. Placement of CCRs in the mine backfill ceased in January 2008 and NTEC has no future operational plans for placement of CCRs in the mine backfill at Navajo Mine. Additionally, NTEC's proposed Pinabete Permit does not seek authorization from OSMRE to use CCRs as part of its reclamation practices.

2.4 Action Area

The Action Area evaluated for this BA includes all areas that the Proposed Action may directly or indirectly affect (Figure 2-1). This area where direct effects would potentially occur includes the areas for existing and proposed new mining within the Navajo Mine lease, associated ROWs, the lease area for the FCPP and associated facilities, and the ROWs for PNM and APS transmission lines. The area where indirect effects may occur includes the area that atmospheric deposition from the FCPP emissions would occur, as modeled by AECOM on behalf of APS, and the San Juan River within and downstream of the Deposition Area, which may be affected by runoff of materials from the Action and Deposition areas.

2.5 Specific Operations

2.5.1 Navajo Mine

2.5.1.1 Current Lease Area

The Navajo Nation granted a 24,000-acre coal lease in July 1957 to Utah Construction and Mining Company (subsequently BNCC). On April 29, 2013, the Navajo Nation Council formed the Navajo Transitional Energy Company (NTEC) and on December 30, 2013, NTEC acquired 100 percent of the equity of the Navajo Mine from BNCC. The lease area is subdivided into six administrative resource areas known as Areas I, II, III, IV North, IV South, and V. The current operations of the Navajo Mine are conducted within an existing SMCRA permit area (NM0003F) that includes Areas I, II, III, and portions of Area IV North (Figure 2-2). This area of current operations is known as the Navajo Mine Permit Area. The proposed Pinabete Permit Area includes portions of Area IV North and Area IV South. The history and current status of each resource area is summarized in Table 2-1.

Consistent with SMCRA's requirements, NTEC will submit a renewal request for the existing SMCRA permit, OSMRE Permit No. NM-0003F, which is set to expire on September 25, 2014. The existing SMCRA permit authorizes surface coal mining and reclamation on approximately 20,590 acres. In accordance with the regulations at 30 CFR 750.12(c)(1)(ii) and 774.15(a), a valid permit issued pursuant to an approved regulatory program carries with it the right of successive renewal within the boundaries of the existing permit, upon expiration of the permit term.

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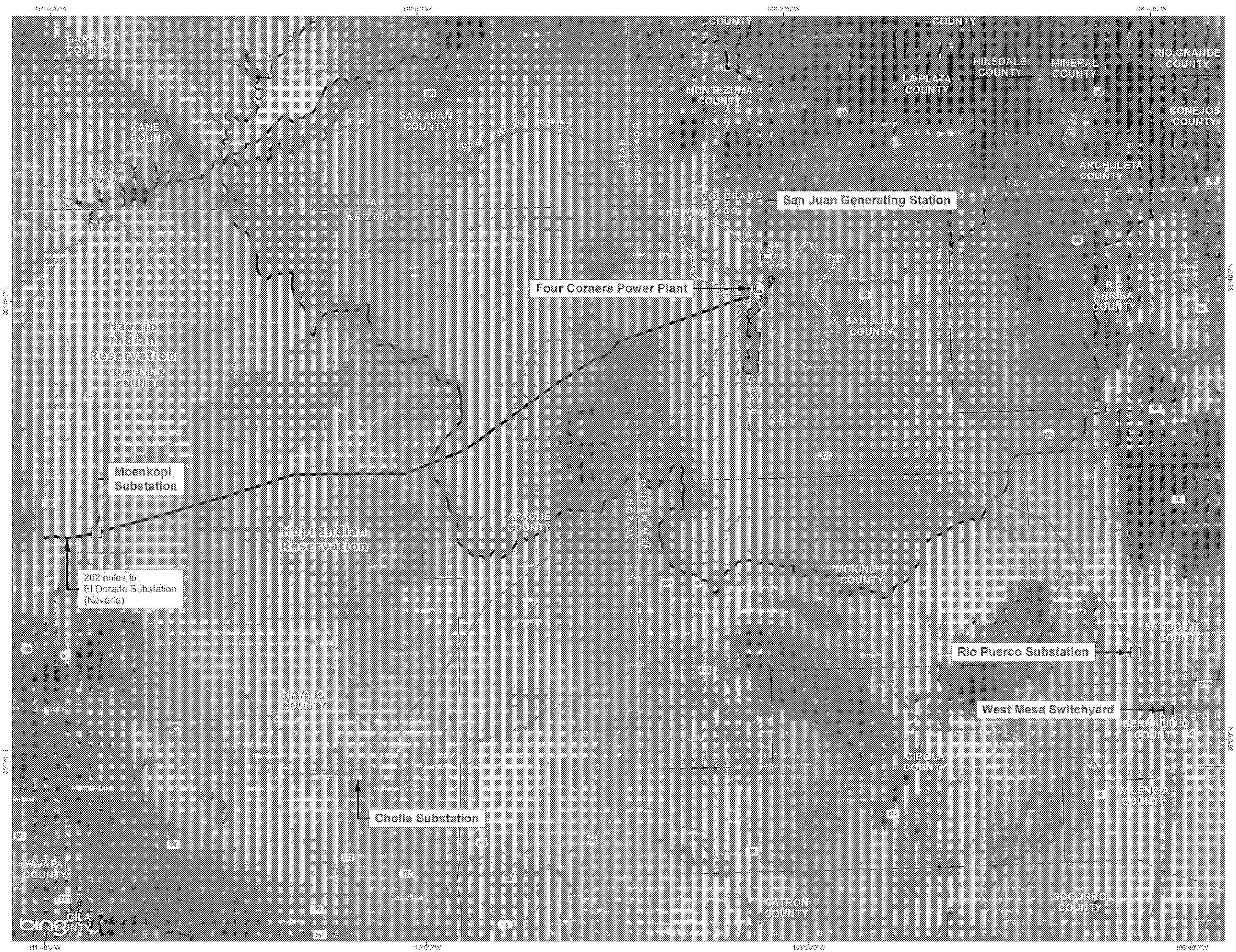


Four Corners

Power Plant and Navajo Mine Energy Project

BIOLOGICAL ASSESSMENT

Figure 2-1
Action Area

PROJECT FACILITIES
- Power Plant
- Substation
- Switchyard

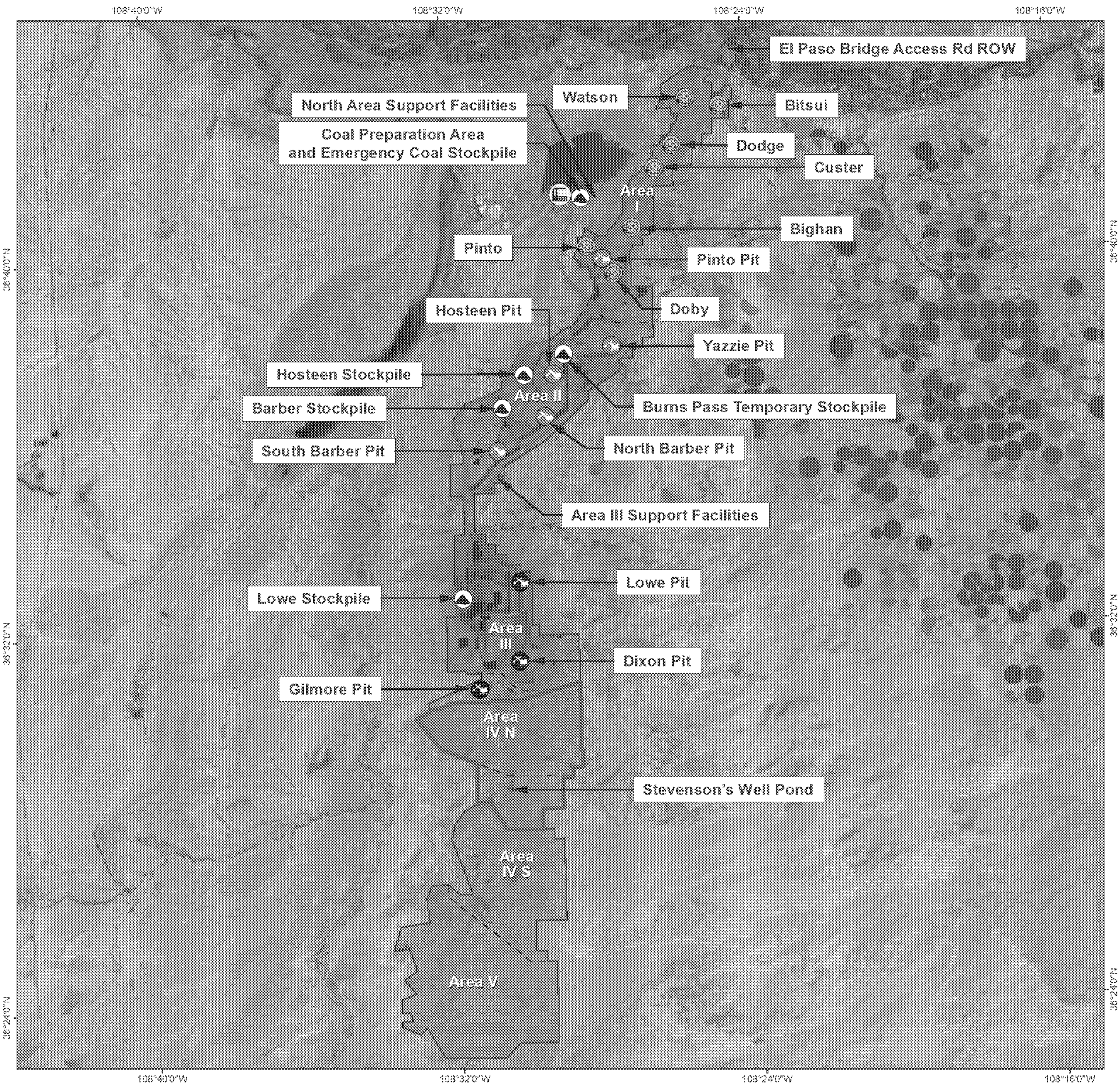
PROJECT BOUNDARIES
- Pinabete Mine Permit Boundary
- Navajo Mine Lease Areas

TRANSMISSION LINES
- 345kV
- 500kV

HYDROGRAPHY FEATURES
- FCPP Deposition Area
- San Juan Watershed

INDIAN RESERVATIONS
- Hopi Indian Reservation
- Navajo Indian Reservation

POLITICAL BOUNDARIES
- State Boundary
- County Boundary



Four Corners Power Plant and Navajo Mine Energy Project

CURRENT OPERATIONS

Figure 2-2
Navajo Mine Lease Area

PROJECT FACILITIES
- Four Corners Power Plant
- Coal Stockpile
- Historic Ash Placement Areas
- Active Mining Pits
- Inactive/Reclaimed Mining Pits
- Topdressing/Regolith Stockpile
- Navajo Mine Railroad

PROJECT BOUNDARIES
- Navajo Mine Lease Area
- Navajo Mine Resource Areas
- Proposed Pinabete SMCRA Permit Boundary

N

0 3.5 7
Scale in Miles

Table 2-1 Summary of Resource Areas

Resource Area	Disturbed/Reclaimed Area (acres)*	Mining Period	Comment
I	4,078/3,614	1960s-1970s	All pits inactive and reclaimed.
II	5,179/2,917	1970s-present	Portions of Hosteen and Yazzie pits kept as contingency reserves, will be mined prior to final reclamation in 2017.
III	3,730/1,434	1980s-present	Lowe and Dixon pits still active. Mining will continue in Dixon pit until approximately 2018 depending upon customer needs.
IV North	268	2012-present	Approximately 268 acres mined.
IV South			Not currently permitted, no mining has occurred.
V			Not currently permitted, no mining has occurred.

*Acreage represents mining and disturbance land status as of July 2011.

Considering that the permit term will expire prior to OSMRE's anticipated completion of the EIS and prior to the currently expected March 2015 Record of Decision (ROD), OSMRE will administratively extend Federal Permit NM-0003F, allowing NTEC to continue surface coal mining and reclamation operations under the current permit, provided that NTEC has met all renewal application requirements and procedures in accordance with 30 CFR 750.12(c)(1)(ii) and 774.15(a). Upon completion of the EIS, the subsequent issuance of the ROD for the pending Pinabete Permit Application will also address OSMRE's decision on the administratively delayed and pending permit term renewal for Federal Permit NM-0003F.

2.5.1.2 Approval of Pinabete Permit

NTEC submitted an application to develop a new permit area for surface coal mining and reclamation operations for Navajo Mine operations beyond July 6, 2016 (Pinabete Permit Area), to OSMRE in April 2012. OSMRE determined the Pinabete permit application to be administratively complete on May 10, 2012, and OSMRE held informal conferences on August 11, 2012, at the Tiis Tsoh Sikaad (Burnham) Chapter House and August 13, 2012, at the Nenahnezad Chapter House. The information below was provided by the Pinabete Permit SMCRA application. The new permit area would be used to supply coal to FCPP and fulfill NTEC's coal sale obligations through 2041 in 5-year permit renewal increments.

The proposed Pinabete Permit Area includes 5,569 acres and would be composed of portions of the current Navajo Mine Permit Area (portions of Area IV North, OSMRE Permit No. NM-0003F) and additional unpermitted areas of the Navajo Mine Lease Area (Area IV South; see Figure 2-3). Table 2-2 summarizes the estimated acres of mining stripline disturbance over the 25-year life of the permit area.

2.5.1.3 Mining Operations

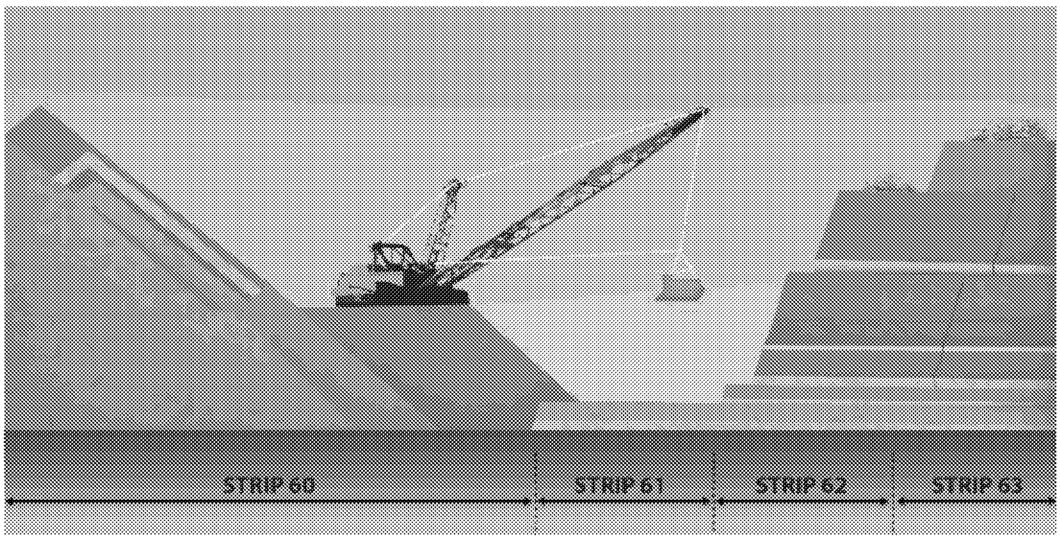
Current and future mining operations at Navajo Mine and the Pinabete Permit Area are described in the following sections. A more complete description can be found in the Draft EIS (OSMRE 2014).

The Navajo Mine is located on the western flank of the San Juan River Basin. Coal-bed methane, coal, and conventional oil and gas are all extracted from this area (Papadopoulos 2006). All coal mined at the Navajo Mine exists within the Fruitland Formation, the shallowest coal-bearing formation. The extent of the Fruitland Formation's coal seams differs across the Navajo Mine Permit Area. Eight primary coal seams and eight corresponding overburden or interburden horizons are present within the Navajo Mine Permit Area (BNCC 2009). Individual coal seams are as much as 20 feet thick and average 6 feet in thickness.

Dragline stripping is the primary mining method used for multiple seam mining operations at the Navajo Mine. The typical sequence for multiple seam mining is as follows:

- Vegetation and topdressing removal
- Overburden drilling and blasting
- Overburden removal
- Coal drilling and blasting
- Coal removal
- Interburden drilling and blasting
- Interburden removal

As shown in the schematic illustration below, the coal seams at the Navajo Mine are exposed in pits that range in width depending on the size of the dragline equipment that is being used to expose them. Pit depths range from 5 to 240 feet and pit lengths range from 1,000 to 15,000 feet. Each pit is stripped by slowly moving the dragline across the pit in parallel cuts called "strips." Table 2-3 lists the equipment currently used daily at the Navajo Mine.



Schematic of Dragline Operation

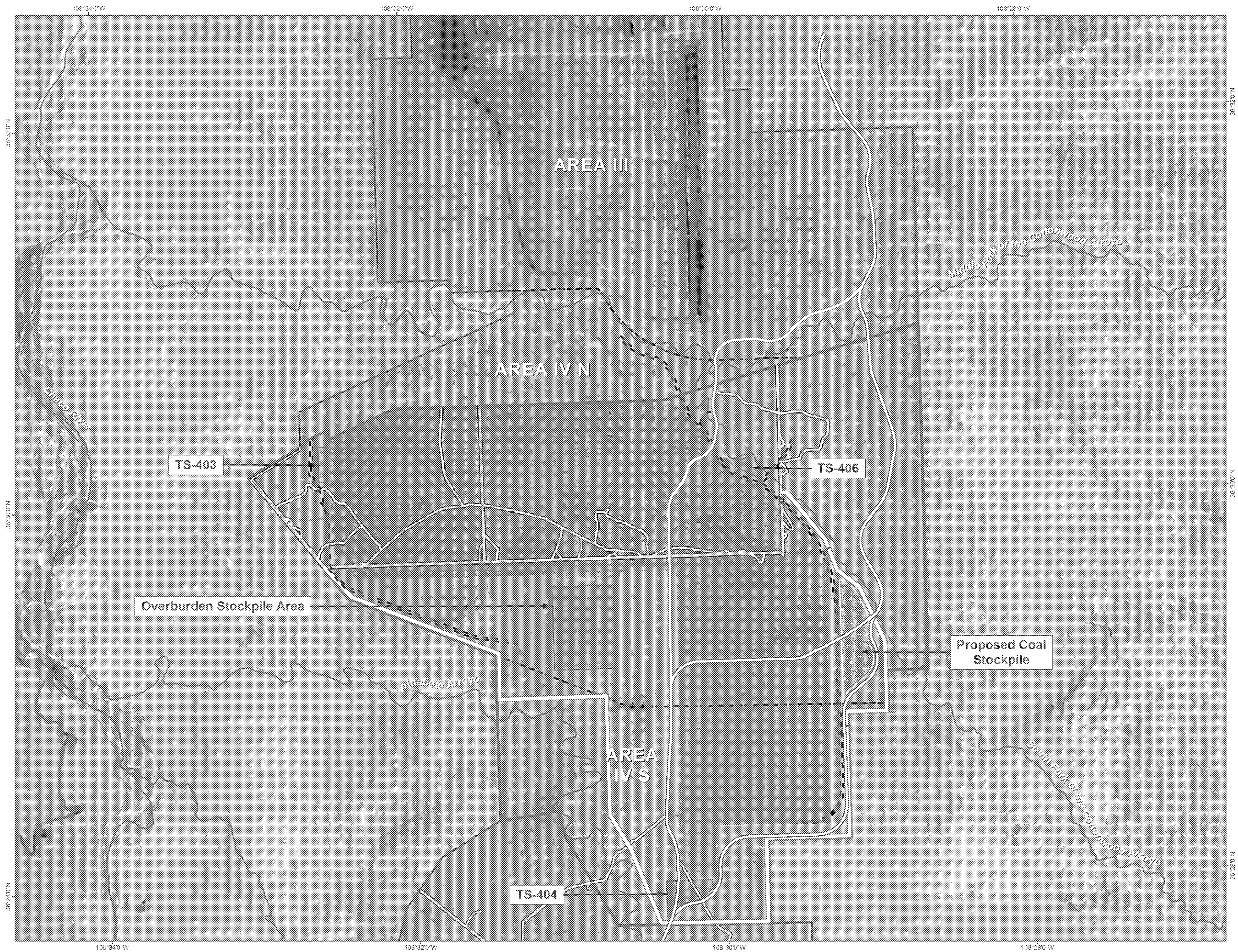
Photograph of Dragline Operation at the Navajo Mine (Source: BNCC)

Four Corners Power Plant
and Navajo Mine Energy Project

ALTERNATIVES

Figure 2-3

Proposed Pinabete Permit Area
and Burnham Road Realignment



PROJECT BOUNDARIES

Navajo Mine Lease Area

Navajo Mine Resource Areas

Proposed Pinabete Permit Boundary

PROJECT FACILITIES

Topdressing Stockpile

Mining Disturbance Area

Proposed Field Coal Stockpile

ROAD NETWORK

Existing Burnham Road

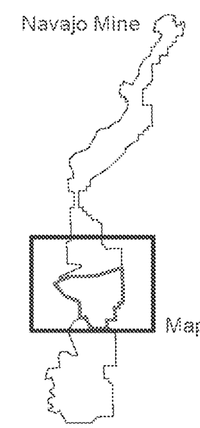
Proposed Burnham Road

Vacated Burnham Road

Proposed Haulroad

Proposed Ancillary Roads

Existing Ancillary Roads



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0 0.25 0.5 1

Scale in Miles

Table 2-2 Estimated Acres Disturbed by Mining by Year in the Pinabete Permit Area

Permit Term	Year(s)	Acres Disturbed
1	1	101
	2	115
	3	89
	4	88
	5	89
2	6-10	746
3	11-15	512
4	16-20	636
5	21-25	368
	Total	**2,744**

Table 2-3 Equipment Use at the Navajo Mine

Equipment	Typical Number in Operation[1,2] Navajo Mine	Typical Number in Operation[1,2] Pinabete Permit
Draglines	3	3
Overburden Drills	3	3
Coal Drills	1	2
Track Dozers	12	13
Rubber Tire Dozers	1	2
Front-end Loaders, Large	7	7
Front-end Loaders, Small	3	4
Graders	4	6
Scrapers	3	3
Coal Haul Trucks	5	5
End Dump Haul Trucks	8	7
Mix Trucks	2	2
Water Trucks	3	4
Cable Reels	2	2
Locomotives	5	4
Railroad Cars	57	42
Stemming Truck	1	1

Source: OSMRE 2012a,b

[1] The types and number of equipment are subject to change during the permit term due to fluctuations in production levels, equipment outages, and equipment replacement schedules.

[2] The listed equipment would be shared between the two areas and could not be used in both areas simultaneously. Thus, the maximum amount of equipment that would be used at a single time is the maximum amount listed under either area.

Exploration Drilling

Historically, BNCC, and now NTEC, would periodically conduct development drilling and sampling to delineate and characterize coal, overburden, interburden materials, and hydrologic conditions, or to perform geotechnical evaluations in both active and future mining areas. Drilling and sampling are the primary means of determining the depth, thickness, physical and chemical characteristics, and degree of hydrologic saturation of the geologic materials to be disturbed or otherwise affected by mining. A site-specific drilling plan is typically prepared for each program that specifies the number of holes, locations, drill depths, access routes, and post drilling reclamation; however, each drilling program generally involves the following common activities:

- Establishment of staging area
- Construction of temporary roads
- Drilling, sampling, and geophysical surveying of completed drill holes
- Subsequent reclamation of all disturbances outside of the 5-year affected lands area

Exploration activities can occur at the same time and in proximity to ongoing surface mining operations. All drilling activities adhere to the following criteria:

- Drilling is conducted with air or air-water mist whenever practicable to minimize the use of drilling mud.
- Drilling sites and associated access roads are located in a manner to minimize disturbance and effects on environmental resources (e.g., drainages).
- Minimal excavation and/or site preparation may be required at drill sites, including grading.
- In the event a mud pit is required, a maximum of 12 inches of soil material is stockpiled immediately adjacent to the mud pit, and the extent of the mud pit is kept to the minimum practicable.

All surface disturbance associated with drilling is reclaimed and exploratory boreholes are abandoned. Exploration holes, boreholes, and wells are backfilled and sealed to eliminate hazards to people, environment, and machinery using the following criteria:

- Exploration holes or wells located in areas planned for mining are backfilled and sealed using cuttings and/or bentonite “hole plug.”
- Exploration holes or wells located outside of areas planned for mining and where water is not encountered are backfilled and sealed using cuttings and/or bentonite “hole plug” to approximately 5 feet from the collar and then stemmed to the top with concrete grout.
- Exploration holes or wells located outside of areas planned for mining and where water is encountered are backfilled and sealed with concrete grout from the bottom of the hole to at least 20 feet above the top of the uppermost water-bearing stratum. The hole is then filled with cuttings and/or bentonite “hole plug” to approximately 5 feet from the collar and then stemmed to the top with concrete grout.

All drilling locations and associated access roads are reclaimed as soon as practicable upon completion of the drilling program. In the event that mud pits are excavated at the drill site, the collected wet cuttings and/or drilling mud are allowed to dry before being covered with excavated material and the replacement of any salvaged soil. Reclamation of the drilling locations and access roads consist primarily of disking, seeding, and mulching the drill sites. Any abandoned underground openings found during mining are fenced or filled with spoil or other earthen materials using available mining equipment to minimize health, safety, and environmental hazards.

Vegetation and Topdressing Removal

Within the Pinabete Permit Area, 4,104 acres of the 5,569 acres would be disturbed as a result of the mining operation and support facilities. The immediate mining area, i.e., striplines and pits, would disturb approximately 2,744 acres, while the proposed support facilities would disturb approximately 1,360 acres (see Table 2-4 for a breakdown of the vegetation types that would be disturbed by mining in the Pinabete Permit Area).

Table 2-4 Vegetation Types That Would Be Disturbed Within the Pinabete Permit Area

Vegetation Type	Acres
Alkali Wash	1,273
Arroyo Shrub	31
Badlands	836
Dunes	267
Sands (Sandy Soils)	1,094
Thinbreaks	603
Total Area of Disturbance	**4,104**

Similar to the Navajo Mine Permit Area, past soil investigations of the Pinabete Permit Area by BNCC have determined that negligible topsoil exists within the area; any material that is deemed suitable for plant growth is, therefore, considered a "topsoil substitute."

SMCRA defines topsoil as the A and E soil horizons. They are the uppermost soil horizons of a soil profile and are characterized by accumulations of organic matter (A horizon) or intensely weathered and leached horizons that have not accumulated organic matter (E horizon) (BNCC 2012a). Navajo Mine has a negligible amount of topsoil within its lease area, consistent with its regional desert location. Therefore, NTEC uses a topsoil substitute material for reclamation. Soil material used as topsoil substitute at the Navajo Mine is defined based on their location within the soil profile. The material within the top 60 inches of the profile is called "topdressing," and the material found deeper than 60 inches is called "regolith."

The suitability of salvaged topdressing and regolith to be used as topsoil substitute is determined by the *Navajo Mine Topsoil and Topsoil Substitute Suitability Criteria*, Chapter 11, Table 11-2 (BNCC 2009) and is determined through a sampling program that tests for texture, saturation percentage, pH, electrical conductivity, sodium adsorption ratio, coarse fragments, erosion factor, and soluble selenium. Soil analyses are submitted to OSMRE annually along with field descriptions and a map of the sample locations.

Topdressing is removed ahead of mining activities to prevent contamination from rocks that are dislodged by the blasting operations, as well as to accommodate mining support infrastructure such as roads. Certain soils cannot be removed without jeopardizing the safety of the operators and equipment or diminishing the quality of the topdressing salvaged. Because of these limitations, topdressing is not salvaged where:

- Slopes are greater than 4 horizontal to 1 vertical (4h:1v or >25 percent).
- Suitable surface deposits are less than 6 inches (this soil is too shallow to allow removal without considerable contamination from underlying unsuitable material).
- Areas are less than 1 acre in size.
- Areas where rock rims and/or rock outcrops exist.

For environmental protection of the topdressing resource, the maximum allowable lateral limit of topdressing removal in advance of the active mining area is 1,800 feet beyond the current extent of mining, measured from the top edge of the highwall.

Topdressing removal activities are conducted in opportunistic blocks that maximize the direct haul and respread of topdressing in active reclamation plots, limiting the need for stockpiles. If stockpiling of topdressing and regolith is necessary, the two are segregated and separately stockpiled. If regolith is sampled and determined to be a suitable topsoil substitute, it can be stockpiled with topdressing material. A perimeter berm or other equivalent surface-water control structure is constructed around the stockpile to minimize material loss through water erosion and to prevent sediment from entering undisturbed areas and streams. In addition, the stockpile surface is stabilized by mulching and seeding. Topdressing stockpiles that are to remain undisturbed for 6 to 12 months are mulched, while those that are to be undisturbed for a year or greater are seeded and mulched during the next appropriate seeding period. After a stockpile is depleted, the storage area is surfaced with suitable topdressing so that it may also be reclaimed. All topdressing stockpiles are clearly marked so that other mining activities do not inadvertently disturb or contaminate them. Berms and ditches are inspected on a routine basis and repaired as needed.

For the Pinabete Permit Area, salvaged topdressing material will be placed in the one existing or either of two future stockpiles planned for the Pinabete Permit Area. Topdressing stockpile TS-403, located in the northwestern corner of Area IV North, was constructed in 2010 under Navajo Mine Permit NM-0003F and has a maximum capacity of 250,000 cubic yards. Topdressing stockpile TS-404, located at the southern boundary of Area IV South, is planned for construction in 2024 with a maximum capacity of 1.2 million cubic yards. Topdressing stockpile TS-406, located in the northeastern corner of Area IV North, is planned for construction in 2022 with a maximum capacity of 60,000 cubic yards (Figure 2-3). In general, topdressing is not removed from stockpiles until required for redistribution on graded areas. However, stockpiles may be relocated to facilitate mining and/or reclamation. Information on the volume of relocated topdressing is provided to OSMRE prior to and upon completion of the reclamation activities.

NTEC estimates that during the life of the Pinabete Permit Area it would haul about 5.8 million tons of coal and 6 million cubic yards of other materials annually. NTEC would use a dedicated fleet of vehicles to perform all coal hauling, topdressing removal, overburden prestripping, spoil mitigation, interburden removal, regrading, and topdressing replacement activities.

Overburden and Coal Removal

Native rock overlays (overburden) and lies between coal layers (interburden) and must be removed to access the coal. This material is removed by blasting using bulk explosives (typically consist of ammonium nitrate and fuel oil [ANFO], an emulsion and ANFO blend, or bagged slurry product) under the supervision of OSMRE-certified blasters, followed by removal of the broken-up material with draglines, dozers, front-end loaders and trucks, depending on the size and configuration of the area. This material is removed in parallel cuts, or "strips," with each contiguous sequence of strips comprising a pit. Pits vary in depth from 5 to 240 feet (measured from the topographic crest to the toe of the highwall), depending on the stratigraphic location of the recoverable coal seams and individual operating constraints. In most cases, a minimum pit width of 100 feet is required to facilitate safe operation of the mobile mining equipment. Pit length varies from 1,000 to 15,000 feet, depending on pit geometry and planned mining sequence. Overburden and interburden material is moved to the side as the pit is developed and coal seams are removed.

After the coal is exposed by stripping operations, the coal layer is removed using the same techniques described above for the overburden and interburden materials, with the exception that the coal is removed with large front-end loaders and hauled in large-capacity haul trucks along the primary roads to field coal stockpile locations, adjacent to the rail line. Once a layer of coal is removed, the underlying interburden material is then removed using the techniques described above to expose the next layer of coal, which is then blasted and removed. This process is repeating until the lowermost layer of coal has been removed. The area is then backfilled as the next strip is mined. Large front-end loaders transfer coal from the stockpiles to the electric train for delivery to FCPP. The Navajo Mine has four permitted and active coal stockpiles: Barber (Area 2), Hosteen (Area II), Lowe (Area III), and an emergency stockpile (Area I) (see Figure 2-2). The stockpiles have capacities of 1,500,000, 800,000, 2,700,000, and 80,000 tons, respectively. In addition, the Burns Pass Temporary Coal Stockpile is located in Area 2, which is intended to add additional storage capacity when the Hosteen and Barber field coal stockpiles near capacity. This stockpile was permitted in 2007 and has yet to be used. However, once the contingency coal reserves in the Area 2 Hosteen and Yazzie pits are mined, it may be operationally beneficial to utilize this stockpile. The Pinabete Mine Plan includes one future coal stockpile area, to be constructed in 2024, operational in 2025, and removed in 2041 (Figure 2-3). The stockpile would be located in the eastern part of Area IV South, adjacent to the proposed Burnham Road realignment, with a maximum capacity of 1,000,000 tons. NTEC maintains approximately 1 million tons of coal as minimum working inventory available for coal blending. This amount represents about a 1.5-month reserve supply of coal.

Coal Production

Navajo Mine has a contract with the FCPP's owners to supply coal through the year 2016 and a subsequent contract with a 15-year term for post-2016 coal supply. The tonnage per year is subject to change depending on the FCPP's demand for power and the availability of equipment. Recent production volumes and acres mined are provided in Table 2-5.

Table 2-5 Recent Coal Production Volumes at the Navajo Mine

Year	Volume (tons)	Acres Mined
2009	8,967,000	246
2010	8,629,000	154
2011	8,825,000	152
2012	8,571,000	203

Source: BNCC 2012a

The anticipated tonnage to be mined from the Pinabete Permit Area and from the Navajo Mine Permit Area for each fiscal year of the initial permit term and each 5-year period thereafter is presented in Table 2-6. Annual total tonnage may be subject to change depending on the demand for coal and availability of mining equipment. The estimated annual production needed to fulfill the proposed future coal sales to the FCPP is approximately 5.8 million tons annually. The annual average may decrease in the last permit term, when it is anticipated that mining will only occur for the 3 years.

Table 2-6 Anticipated Coal Production by Permit Term for the Pinabete and Navajo Mine Permit Areas

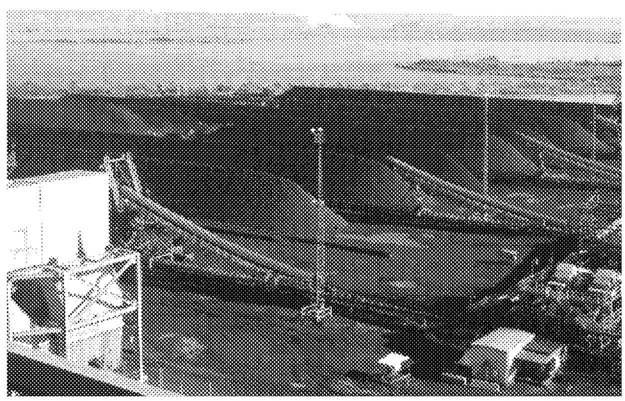
Permit Term	Year(s)	Coal Mined (million tons)
1	1	6,276
	2	5,380
	3	5,303
	4	6,178
	5	5,858
2	6-10	29,290[1]
3	11-15	29,290[1]
4	16-20	29,290[1]
5	21-25	17,574[2]
	Total	**134,439**

[1] 5.858 million tons of coal mined per year for a total of 29,290 million tons over 5 years.

[2] 5.858 million tons of coal mined for the first 3 years and 0 ton mined during years 4 and 5.

Coal Handling, Quality, and Delivery

NTEC operates a 15-mile private railroad within its lease area and associated ROWs for hauling coal from field stockpiles to the coal preparation plant in Area I, adjacent to the FCPP (as depicted on Figure 2-2). Each train typically consists of approximately 20 railcars and is powered by one electric locomotive. NTEC is capable of running three trains along the rail line, but historically has run only two trains at a time. Typical railroad operations include loading one train at the field coal stockpile while the other train is in transit to or from delivering coal at the coal preparation plant. The trains historically have averaged 12 trips a day over three 8-hour shifts and have run 20 shifts per week. In the rare instances where the railroad is unavailable to deliver coal to the preparation plant, NTEC may haul coal using haul trucks from one of the three field stockpiles (shown on Figure 2-2) directly to the coal preparation plant.



Coal preparation facility at Navajo Mine

The coal preparation plant is a stacking and reclaiming facility and not a coal cleaning operation. A small amount of water is used for dust suppression and housekeeping purposes to remove coal fine accumulations from the equipment. The dust suppression washdown water and any surface-water drainage is directed to a sedimentation pond that is designed to handle the runoff from a 100-year/6-hour precipitation event (total containment pond) and for no discharge. If this sedimentation pond nears capacity, the contents are pumped to Pond 1 Cell A2, another 100-year/6-hour (total containment) pond and allowed to evaporate. The coal fines and sediment retained in the total containment ponds are excavated and placed in the bottom of the mining pits. Therefore, no water or coal plant wastes are discharged from the facility area. Hopper, feeders, and conveyor belts within the coal preparation plant and taking coal to the FCPP are equipped with dust suppression equipment.

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Surface Water Management

In accordance with the requirements of SMCRA and the Clean Water Act, the discharge of runoff from disturbed areas is controlled and treated in a manner that protects receiving streams from excessive sediment and other pollutants.

During mining operations, diversion structures such as berms or ditches are used to convey surface-water runoff from active mining and reclamation areas to containment or treatment facilities such as the mining pit, sump, or sediment pond. The retained water is evaporated, used to suppress dust on haul roads, or discharged in accordance with the NPDES permit conditions.

Photograph of Sediment Pond

NTEC uses engineered structures (e.g., diversions, sediment ponds, detention ponds, impoundments) and other best management practices (BMPs) to comply with the NPDES effluent limitations for point-source and stormwater discharges. BMPs include, but are not limited to, minimizing disturbed areas; surface stabilization, such as mulching and temporary seeding; and check dams and sediment traps. All Navajo Mine operations are conducted in accordance with an individual NPDES permit to cover possible discharges from the Navajo Mine Permit Area (which would be amended to cover Pinabete Permit Area as well). In addition, NTEC is required to obtain the MSGP under Sector H for coal mines and coal mining-related facilities (e.g., haul roads and access roads). Runoff from disturbed mining and reclamation areas is managed by retaining the effluent or surface runoff from the disturbed areas in sedimentation ponds for evaporation. Professional engineers design and certify these ponds to contain runoff from a 100-year/6-hour or 10-year/24-hour storm event. Should discharges occur from these ponds, they are subject to the applicable NPDES discharge effluent limitations of the individual NPDES permit.

Water Use

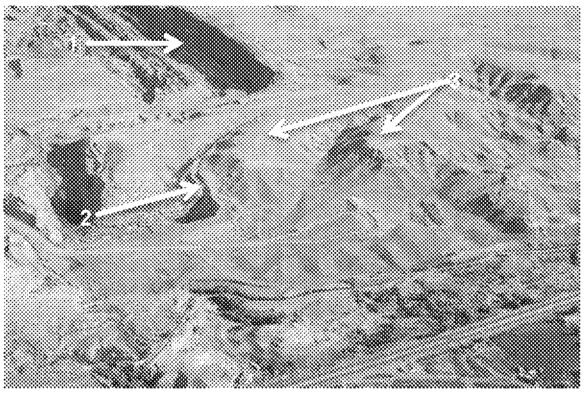
All water use at Navajo Mine (dust suppression, evaporation associated with impoundments, and related mining activities) is drawn from Morgan Lake after diversion from the San Juan River pursuant to Permit 2838.

Reclamation

As mining progresses, disturbed areas are reclaimed. Reclamation is done in large blocks through a mass balance approach. Reclamation blocks become available every 1 to 3 years. Using large blocks provides for a more consistent topography between regraded areas, minimizes the disturbance of areas that have already been reclaimed, and increases operational efficiencies by regrading larger reclamation blocks. Additionally, the number of temporary drainage and sediment control structures can be reduced by regrading larger portions of the post-mine watersheds.

Throughout the reclamation process, surface runoff is controlled and routed into sediment ponds to prevent sediment runoff into natural drainages. Erosion control measures are sufficient to minimize the erosion rate to less than or equal to pre-mine levels. Reclamation includes:

- Removal of all temporary structures and unneeded surface-water control structures
- Contouring reclamation areas to blend with the native drainages that surround the permit area, achieving approximate original contour (AOC), also called the final surface configuration, in accordance with SMCRA regulations
- Placement of topdressing, or topsoil substitute material suitable for plant growth, over the regraded spoils
- Preparation of the seedbed and seeding of the area using a native seed mix suitable for livestock grazing and wildlife
- Mulching of the seeded area to minimize erosion, protect the seed, and reduce evaporation
- Irrigation as needed from May to mid-October for the first 2 years after revegetation to establish a diverse, effective vegetation cover
- Monitoring for success



This photograph illustrates reclamation areas being recontoured to blend with native topography (AOC). Arrow 1 shows the pit outline being backfilled. Arrow 2 shows the backfilled area reestablishing connection with native topography. Arrow 3 shows completed contouring. Note that the photograph depicts the nearby San Juan Mine.

Photograph of Active Reclamation Area in the North Barber Pit, prior to revegetation.

The post-reclamation topography is designed to approximate the pre-mine relief and contour, stabilize the surface and prevent excessive erosion, and introduce topographic diversity that enhances vegetation re-establishment and provides a condition capable of supporting the designated post-mining land use as rangeland for domestic livestock grazing and wildlife habitat.

Backfilling and grading operations of each logical block would be divided into primary and secondary regrade operations. Primary regrading operations would use track dozers to level off the spoil ridges. Primary regrading would be accomplished as necessary to accommodate the final surface configuration and reclamation schedule. Some pits and ramps might not have sufficient backfill material readily available for track dozers to adequately regrade the area. In these instances, supplemental equipment (e.g., scrapers, draglines, end-dump trucks) may be used to assist primary regrading activities by redistributing existing backfill material. Secondary regrading may, if needed, follow primary grading for additional contouring of the land surface to accommodate topdressing replacement.

During the process of secondary grading, small depressions may be established on an opportunistic basis. These features are intended to enhance post-mining topographic diversity and act as seasonal surface-water collection sites. Highwalls and ramps would be backfilled and graded per the modeled final surface configuration design plan. Portions of highwalls may remain in the final surface configuration as bluff-like features to replace natural escarpment features for wildlife habitat. Rock habitat structures would be constructed within reclaimed areas to provide wildlife habitat.

Regraded spoils are systematically sampled for root-zone suitability and mitigated with suitable root-zone material as required. Unsuitable root-zone material may be disposed of in the mined-out pits or left in place and capped with suitable root-zone material. Salvaged topdressing material, from either stockpiles or in-situ sources, is then redistributed using haul trucks, dozers, and graders on the regraded plot. The topdressed areas are prepared for seeding using standard agricultural practices (e.g., ripping and disking) to reduce soil compaction and prepare the seedbed for seeding. Depending upon the level of compaction, dozers, graders, or standard agricultural tractors may be used to prepare the seedbed.

In general, reclamation activities would seek to establish geomorphically appropriate features consistent with the native landscape. However, in some instances this approach might not be feasible or applicable. In these instances, NTEC would implement a traditional reclamation approach based on "hard-engineered" structures (e.g., placement of riprap or terraces). NTEC has designed the post-reclamation topography and drainages within the Pinabete Permit Area to blend with existing drainages along its perimeter and convey water from undisturbed upstream, off-lease watersheds to either Pinabete Arroyo or Cottonwood Arroyo. Cottonwood and Pinabete arroyos would not be mined under the Proposed Action. Mining operations would temporarily intercept precipitation runoff from the tributary drainages that flow into Cottonwood and Pinabete arroyos from the permit area. No stream diversions are anticipated to be required for the Pinabete Mine Plan. Once reclamation is completed within the permit area, precipitation runoff from these reclaimed areas would flow through reclaimed channels to Cottonwood Arroyo, Pinabete Arroyo, the unnamed tributary to the Chaco River, and then into the Chaco River.

The reclaimed areas are revegetated to ensure that the land is capable of supporting the post-mining land use, which is designated as livestock grazing and wildlife habitat. Revegetation would be initiated on areas that have been graded and topdressed. Revegetation activities, including seeding, mulching, and irrigation applications, may begin as early as January and will be completed by the end of October. Seed mixtures were developed utilizing the research and experience gained from revegetation programs at Navajo Mine and San Juan Coal Company's San Juan Mine. NTEC has developed seed mixes that utilize up to 21 different native plant species: 10 grasses, 4 forbs, and 7 shrub species that are all native to the San Juan River Basin.

The irrigation system for the permit areas would consist of a solid-set system, which uses various sizes of aluminum pipe to cover the vegetation block. This system allows for optimum timing and scheduling and has led to more efficient water use without adverse effects on seed germination and vegetation establishment. Irrigation would be applied to the revegetation blocks from March to mid-October, but may vary depending upon natural precipitation and temperatures. Small areas of reseeding, interseeding, or first-time seeding may not be irrigated based on their size and proximity to irrigation delivery lines and pumps. The irrigation schedule for the first growing season would be divided into a germination cycle and support cycle. During the germination cycle, it is anticipated that approximately 4.6 inches of water would be applied over the course of 13 days; and, during the support cycle, approximately 0.57 inch of water would be applied approximately every 2 weeks beginning immediately following the germination cycle and continuing through mid-October.

Revegetation blocks may receive light irrigation during the second growing season to promote root development. This irrigation would generally be a one-time application of approximately 1.15 inches of water over 5 hours. Additional irrigation may be applied during drought periods. The water source for irrigation is the San Juan River, via Morgan Lake, pursuant to rights held under New Mexico Office of the State Engineer Permit 2838. Water is diverted from the San Juan River to Morgan Lake, pumped into a pond at Navajo Mine North Facilities and, subsequently, transported via pipelines to the irrigation plots.

Revegetation success studies would be conducted, as needed, during the responsibility period to identify trends in the revegetation communities and to evaluate the progress of the revegetation effort. The minimum length of the bond responsibility period is 10 years. Bond release revegetation studies would be conducted to evaluate whether the revegetated community has developed into a diverse, stable, and self-sustaining vegetation community, specifically by comparing 2 out of the last 4 years of the bond period to success criteria. Bond release studies may be conducted 6 years after any augmented seeding, fertilizing, irrigation, or other similar activity, excluding approved grazing or husbandry practices. All revegetation sampling, interim, and bond release studies would be conducted between June and October to provide for a sampling period that would result in the highest expression of revegetation species. Before collecting bond release samples, the areas proposed for sampling will be discussed with OSMRE. The sampling and subsequent determination of whether revegetation fulfilled bond release requirements would be conducted in accordance with the SMCRA permit.

To demonstrate revegetation success, the revegetated communities would be compared to the approved Area IV North reference areas from the Navajo Mine Permit Area. These reference areas are located outside of mining activities, are of sufficient contiguous size to adequately determine vegetation success parameters, are similar in plant composition to baseline vegetation communities, and are able to be managed in a manner similar to the restored areas to which they will be compared. Reference areas are posted to identify the areas as reference areas and fenced to control livestock grazing. These areas are managed similarly to the reclamation areas (areas that have been regraded, topdressed, and seeded) to which they will be compared. Both areas, reference and reclamation, will experience the same management practices within a given year. In the event that future mining-related activity effects the reference areas, potential replacement reference areas would be identified either within or outside of the permit or lease area.

To determine revegetation success for the permit area, a set of standards would be established that would be used to compare the reclaimed lands to a reference area. The revegetated community must meet the revegetation success criteria in any 2 of the final 4 years of the bond period. Revegetation success criteria would include annual success criteria for total vegetative cover (i.e., percent cover of live plants plus litter), and total vegetation production (i.e., annual and perennial vegetation production), as well as technical standards shrub density, and species diversity.

Waste Disposal

Coal Mine Waste and Disposal

NTEC does not generate coal mine waste or coal processing waste (as defined by 30 CFR 701.5) or accept it from outside sources. Small quantities of coal spilled around the mine operation are routinely picked up and placed in mined-out areas.

Photograph of Active Reclamation in Area II following revegetation

Limited quantities of potentially acid- and toxic-forming materials (PATFMs) may be encountered during mining operations. PATFMs are materials that exceed root-zone suitability standards, that is, materials that have a pH less than 5 standard units (su) and a pH value greater than 9 su, an acid-base account less than -5 tons of $CaCO_3$/1,000 tons, greater than 2.5 parts per million (ppm) of total selenium, or greater than 0.26 ppm of soluble selenium. Of the more than 13,000 root-zone samples collected at Navajo Mine between 1991 and 2011, less than 4 percent of samples were unsuitable for pH values, less than 1 percent were unsuitable for acid-base account values less than -5 tons of $CaCO_3$/1,000 tons, less than 1 percent were unsuitable for total selenium values, and less than 1 percent were unsuitable for soluble selenium values based on NTEC's root-zone suitability criteria (Table 12-3 OSMRE Root Zone Suitability Criteria for Navajo Mine, Chapter 12, NTEC SMCRA Permit NM-0003F).

Initial geologic analysis and overburden characterization indicates no widespread occurrence of PATFMs within the Pinabete Permit Area. Instead, the characterization suggests a net alkaline environment for the majority of interburden layers across the permit area, although in some locations, the rock strata associated with the interburden above No. 6 coal seam (I6) have soluble selenium concentrations that exceed OSMRE suitability criteria.

Any PATFM encountered would be disposed of in a mined-out area long the bottom of a pit, similar to the coal mine waste described above. NTEC has developed a *Combustibles and Coal Mine Waste Fire Control Plan* that describes procedures that may be used for burying or covering PATFMs and combustibles not suitable for supporting plant growth encountered during reclamation operations.

Other Waste

In compliance with NNEPA, Navajo Nation Solid Waste Regulations Part II, Section 202, all noncoal mine waste, including solid waste and hazardous waste, is removed from the mine site for disposal at an appropriate facility. Non-hazardous, non-coal solid waste is stored in dumpsters located at various designated areas around the mine site. Special wastes, such as used sorbents and oily rags, and hazardous materials are accumulated, managed, and disposed of in accordance with applicable EPA, NNEPA, and U.S. Department of Transportation regulations. All wastes are transported by a third-party contractor to San Juan County Regional Landfill for appropriate handling and disposal.

NTEC may establish a landfarm in accordance with SMCRA and Navajo Nation regulations within the Pinabete Permit Area to bioremediate petroleum-contaminated soils that are collected on site. There are no current plans to establish a landfarm within the Pinabete Permit Area; however, but provisions exist in the permit to establish one if needed.

Buildings and Support Facilities

Existing buildings and support facilities associated with Navajo Mine operations are concentrated in two areas within the existing mine lease:

- The North Area support facilities, covering approximately 70 acres and located adjacent to the FCPP about 4 miles south of the northern end of the Navajo Mine lease
- The Area III support facilities, covering approximately 30 acres and located about 11 miles south of the northern end of the Navajo Mine lease

The Navajo Mine North Area includes a heavy equipment repair shop, carpentry and plumbing shop, fuel and lube tanks, storage yards, tire installation and repair shop, change rooms, heavy equipment ready line, wash bay, sewage facility, coal plant, weld shop, irrigation system pump house, reclamation seed building, reclamation yard, coal lab, railroad yard, warehouse with associated storage yard, communication tower, and offices, field maintenance, and security offices. To the south of the North Area support facilities is a potable water tank that is used for these facilities.

Area III includes an engineering and production office building, equipment maintenance shop, auto repair shop, weld shop, equipment loading dock, vehicle fueling area, propane tank, warehouse with associated-storage yard, change rooms, wash bay, potable water tank, heavy equipment ready line, employee coal stockpile, sewage facility, waste management building, and a safety building and security offices. A second communication tower for the mine radio system transmitter/repeater is located south of Area III.

All of these facilities are currently in use and maintained in good condition. The Navajo Mine area support facilities and associated parking lots are designed to comply with 30 CFR Part 816.181.

No new support facilities are proposed for construction. The main support facility for the Pinabete Permit Area operation would be the existing Area III support facilities. Irrigation and dust suppression water supply would be provided from an extension of the existing raw water pipeline at Navajo Mine. The existing pipeline terminates near the southern end of the Dixon Haul Road in Area III and would be extended to Area IV North and South at a future date prior to beginning irrigation and revegetation for reclamation. All of these support facilities would remain in use for the duration of the permit period (through 2041).

Power for Pinabete Permit Area operations would be supplied over a 69-kV distribution system. The mainline within the permit area would be approximately 13.5 miles long and loop around the mining area. Approximately 5.8 miles of existing powerline were constructed in 2010 associated with Navajo Mine Area IV North development. Approximately 7.7 miles of new powerline are proposed for construction prior to development of the mining operations in Area IV South. In addition, stub lines would be constructed off the mainline at approximately 5,000-foot intervals to service the mining operations. Power lines would be constructed and designed in a manner to prevent electrocution of raptors (Avian Power Line Interaction Committee [APLIC] 2006). Mine communication would be conducted using an existing microwave-based radio and telephone system.

Support Roads

NTEC would use both primary and ancillary roads during mining operations in the Pinabete Permit Area. Primary roads are those used to transport coal and spoil, main access roads to the mining areas used by small and heavy equipment, and access roads to the support facilities. Ancillary roads are those used infrequently by small vehicles for accessing environmental monitoring stations, ponds/water control structures, surveying, and powerline service inspection, as well as haul roads to topsoil stockpiles and temporary roads used during construction of support facilities.

Primary roads are designed by a New Mexico-registered professional engineer to meet the SMCRA performance standards of 30 CFR Subchapter K and the Mine Safety and Health Administration standards and requirements for roads. Road widths for primary roads may vary between 30 and 120 feet wide, include multiple traffic lanes, and may separate light and heavy equipment. Additionally, primary roads are designed, constructed, and maintained in a manner to minimize the contribution of additional suspended solids to surface-water runoff. Primary road crossings would use engineered crossing designed according to all applicable permit regulations. Road crossing and other infrastructure would be designed to minimize the effects to stream channels. Culverts may be placed at topographic lows or areas where roads intersect drainage channels and are designed to safely pass the peak discharge from a 10-year, 6-hour storm event and minimize the alteration of the stream channel.

Ancillary roads are generally constructed using a road grader to create the road surface. Typical widths range between approximately 12 feet for small vehicle roads and approximately 80 feet for topsoil haulage roads. Ancillary roads use low water crossings or culvert crossings depending on the depth of the incised intersecting channels

The Pinabete Permit proposes construction of approximately 5 miles of primary roads and approximately 22 miles of ancillary roads to the Navajo Mine transportation network (Table 2-7; Figure 2-3). Relocating a public access road is the only circumstance under which NTEC would construct roads outside the mine lease; this action would require ROW approval from BIA.

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Table 2-7 Proposed Project Roadways

Road ID	Road Type	Purpose	Length (feet)	Width (feet)	Maximum Grade (%)	Surface Material	Construction Date	Removal or Reclamation Date
East Haul Road and Service Road Loop	Primary	Access/haulage	16,600	120	3.5	Gravel	2023	2041
West Haul Road	Primary	Haulage	10,900	80	NA	Gravel	2025	2041
TS-403 Haul Road	Ancillary	Access/haulage	450	60	1.0	Dirt	2016	2041
TS-404 Haul Road	Ancillary	Access/haulage	NA	NA	NA	Dirt	2025	2041
TS-406 Haul Road	Ancillary	Access/haulage	NA	NA	NA	Dirt	2023	2041
Well PA-1 Access Road	Ancillary	Access	3,235	12	12.5	Dirt	Existing	2041
Well PA-2 Access Road	Ancillary	Access	2,370	12	3.0	Dirt	Existing	2041
Area 4 North Access Road	Ancillary	Access	32,000	12	10	Dirt	Existing	2041
Met Station 3 Access Road	Ancillary	Access	3,500	12	9.5	Dirt	Existing	2041
69-kV Powerline-A4N	Ancillary	Access	30,800	12	10	Dirt	Existing	2041
69-kV Powerline-Pinabete	Ancillary	Access	40,700	12	10	Dirt	2023	2041

Proposed Burnham Road Realignment and Support Road Construction

To conduct operations in the Pinabete Permit Area, NTEC would realign 2.8 miles of the existing Burnham Road to route public traffic around mine activities and traffic (Figure 2-3). Burnham Road would not need to be relocated until approximately 2022. NTEC will submit an application to the BIA for the ROW to realign Burnham Road prior to that date. Burnham Road would be designed by a New Mexico-registered professional engineer to meet state and county road standards.

In November 2012, BNCC submitted applications to BIA for the ROW renewal of the Navajo Mine Access Road, which provides access in Area III. The Navajo Mine Access Road is 4,528 feet long. No improvements or additional construction activities are proposed to this road. In February 2013, BNCC also submitted an application to the BIA for the ROW renewal of the Access Road/Power and Communication lines from APS plant site lease to BNCC coal lease. This ROW is 1.3 miles long and no improvements or additional construction activities are proposed for this ROW. In May 2013, BNCC submitted a ROW renewal for the El Paso Bridge Access Road ROW, which provides primary access from the bridge at the San Juan River near the Nahnanezad School approximately 6.6 miles ending at FCPP. This ROW renewal is in the original location since installation and no changes or additional construction activities are proposed for this ROW. In addition, NTEC would construct two new haul roads, currently planned for construction in 2023 (Table 2-7).

2.5.2 Four Corners Power Plant: Current Operations as of December 2013

Prior to January 1, 2014, when compliance with BART requirements (see Section 2.5.2.2.1) commenced, the FCPP consisted of five pulverized coal-burning steam electric generating units with a total generating capability of 2,100 MW:

- Unit 1, 170 net MW, in service since 1962
- Unit 2, 170 net MW, in service since 1962

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- Unit 3, 220 net MW, in service since 1963
- Unit 4, 770 net MW, in service since 1969
- Unit 5, 770 net MW, in service since 1970

To comply with EPA's FIP for BART and effectuate the Proposed Action, APS had to make a choice of how to comply with BART prior to January 1, 2014. APS determined to proceed with the Proposed Action and BART compliance by retiring Units 1, 2, and 3. However, that compliance occurred, as a result of BART requirements, prior to January 1, 2014. Accordingly, the benefits of retiring Units 1, 2, and 3 are considered part of the Environmental Baseline, as opposed to part of the Proposed Action for purposes of the analysis in this BA.

In addition to the plant's generating units, the plant site contains other ancillary facilities (Figure 2-4) including:

- Morgan Lake and Morgan Lake Dam, located immediately north of the generating units. Morgan Lake is an approximately 1,200-acre human-made reservoir that provides water for industrial and domestic use at the plant, including cooling water. A 155-foot-high earthen fill dam contains the reservoir. All of Morgan Lake is within the FCPP Lease Area and is maintained by the Navajo Nation for recreational uses, including angling, windsurfing, and boating. At maximum capacity, the lake contains 39,000 acre-feet of water. Associated structures include the water intake and discharge structures to and from the lake, cooling water intake structure, a pump house on the San Juan River, a 2.5-mile-long pipeline to bring San Juan River water to Morgan Lake, and a 69-kV transmission line from FCPP to the pump house.
- Fly ash storage silos and bottom ash dewatering bins located south of Unit 5. Lined DFADAs and lined ash impoundments (LAIs) are located west of FCPP's generating units.
- Three FCPP switchyards that connect the FCPP to the following eight high-voltage transmission lines: (1) APS FCPP to Moenkopi Substation, (2) PNM FCPP to San Juan Generating Station, (3) PNM FCPP to West Mesa Switchyard, (4) APS FCPP to Cholla Substation (two lines), (5) PNM FCPP to Pillar/Ambrosia, (6) PacifiCorp FCPP to Pinto, and (7) Western Area Power Administration FCPP to Shiprock.
- Condenser cooling water intake canal located adjacent to the switchyard at FCPP and the condenser cooling water intake structures for Unit 1, 2, and 3 and Units 4 and 5.
- A main access road, which runs north-south directly to the west of Units 1 through 5 turbine enclosures. A second main access road runs east-west from the generating units to the DFADA. Secondary roads provide access to and around area structures, yards, and other ancillary facilities. An employee access road from the bridge crossing the San Juan River to the FCPP.

APS, as operating agent and on behalf of FCPP's participant owners, recently executed a lease amendment (Lease Amendment No. 3) with the Navajo Nation to extend the term of the lease for the FCPP an additional 25 years, to July 6, 2041. The Navajo Nation also consented to renewal of ROWs for the FCPP plant site and for the APS El Dorado and Cholla transmission lines and ancillary facilities, including Moenkopi Substation across Navajo Nation Tribal Trust lands. BIA approval of Lease Amendment No. 3 is required pursuant to 25 USC § 415, and BIA approval of the ROWs is required pursuant to 25 USC § 323. The Hopi Tribe has also consented to the renewal of the ROW for the APS El Dorado line across Hopi Tribal Trust lands.

Four Corners Power Plant
Morgan Lake
Condenser Cooling Water Intake Structure for Units 1-3
Discharge Canal
Combined Waste Treatment Pond
NTEC Coal Blending Piles
Unit 1
Unit 2
Unit 3
Unit 4
Unit 5
230 kV Switchyard
Main Access Road
345 kV Switchyard
Condenser Cooling Water Intake Canal for Units 4 &5
Absorber
Upper Retention Sump
500 kV Switchyard
Warehouse
San Juan River
County Rd 6675 (Project Feature)
Pumping Station Access Road
Morgan Lake
DAM
See Insert Map
108°32'0"W
108°30'0"W
108°28'0"W
108°26'0"W
36°44'0"N
36°42'0"N
Four Corners Power Plant and Navajo Mine Energy Project
CURRENT OPERATIONS
Figure 2-4
Four Corners Power Plant and Ancillary Facilities
PROJECT FACILITIES
Four Corners Power Plant
Pumping Station
Pumping Station Pipeline
PROJECT BOUNDARIES
Four Corners Lease Boundary
Navajo Mine Lease Area
Power Plant Fence Line
TRANSMISSION LINES
345kV
500kV
69kV - Pumping Station to Power Plant
ASH FACILITIES
Existing Active Facility
Existing Inactive Facility
Future Facility
N
0
0.25
0.5
1
Scale in Miles

2.5.2.1 Coal Handling and Processing System

Coal for all of the units is supplied from the adjacent Navajo Mine, using a dedicated electric rail line between the mine and the plant. The train carrying the coal travels uncovered to the plant where it is off-loaded. The coal is delivered from NTEC's Navajo Mine coal preparation plant by electric conveyor belts to the FCPP surge bins. These conveyor belts are covered with a sheet metal enclosure to prevent blowing dust and for personnel protection. A surfactant spray manifold discharges foam onto the open conveyor feed belts below the surge bins to mitigate fugitive dust emissions. From the two 1,500-ton surge bins, the coal is then transported via open conveyor belts to any of nine coal storage silos that support Units 1, 2, and 3, or eight coal storage silos that support Units 4 and 5. The storage silos are equipped with a baghouse/cyclone type dust collector system. Each dust collector has been sized and manifolded to enable adequate dust removal from both surge bins. Once the coal reaches the storage silos, all additional coal transfer operations occur via closed piping. From the storage silos, the coal is transferred to feeders and then to the ball mills, which pulverize the coal.

Photograph of the Coal Handling Area and Conveyor System at Navajo Mine (Source: Cardno ENTRIX)

2.5.2.2 Power Plant Operations

The pulverized coal is dried by and mixed with preheated air and injected into the boilers through low NO_X burners where it is ignited. Low NO_X burners reduce NO_X formation by reducing the flame temperature. Natural gas igniters are used during startup and shutdown for flame stabilization. Prior to their shutdown, at full load, Units 1, 2, and 3 burned approximately 9,000 tons of coal per day. Units 4 and 5 burn approximately 19,000 tons of coal per day.

In Units 4 and 5, which will continue operating under the Proposed Action, hot flue gases pass from the air heater into baghouses and a flue gas desulfurization (FGD) system before discharging out of the flues, which are 380 feet high (flues for both Units 4 and 5 are contained in one stack). The baghouses (fabric filters) remove 99.9 percent of entrained fly ash (particulate matter) in the flue gas, and the FGD system removes 88 to 91 percent of the sulfur dioxide (SO_2). In the FGD system, lime slurry is injected into absorber towers, and the chemical reactions of lime with SO_2 produce calcium sulfite and calcium sulfate solids, which precipitate and create FGD slurry.

The FGD slurry is pumped to thickeners, where solids are concentrated in the bottom, as thickener underflow. The thickener underflow is pumped to the LAI (see Section 2.5.2.5.2 for additional information). The thickener overflow is returned to the scrubbers.

2.5.2.2.1 Beneficial Effects related to Implementation of EPA's Federal Implementation Plan Interim Period (2014-2018)

FCPP shut down Units 1, 2, 3 in December 2013 in compliance with the EPA FIP. If BIA approves the lease amendment and ROWs under federal law, FCPP would continue operation of Units 4 and 5 for the duration of the lease agreement. As part of its BART compliance requirements, APS would install SCR devices on Units 4 and 5. The SCR process requires the use of ammonia, which would be delivered to FCPP by truck and stored on site prior to use. The use of SCR tends to oxidize some SO_2 to sulfites, which results in increased sulfuric acid (H_2SO_4) mist, respirable particulate matter (particulate matter with an aerodynamic diameter of 10 microns or less [PM_{10}]), and fine particulate matter (particulate matter with an aerodynamic diameter of 2.5 microns or less [$PM_{2.5}$]) emissions. Because of these emissions, FCPP will need a PSD permit from EPA because H_2SO_4, PM_{10}, and $PM_{2.5}$ emissions will be above the PSD significant emission threshold. to minimize H_2SO_4, PM_{10}, and $PM_{2.5}$ emission increases, APS proposes to install a dry sorbent injection (DSI) system using hydrated lime as the sorbent. EPA is analyzing potential impacts of the SCR retrofit project to federally listed species under the ESA in consultation with USFWS, and this information is taken into account as part of the environmental baseline in OSMRE's consultation for this Proposed Action.

The SCR process requires the use of ammonia, which would be delivered to FCPP by truck and stored on site prior to use. Depending on the type of ammonia or urea-derived ammonia (liquid or solid) and the number of truck loads required, levels of associated environmental effects and risks differ. A pneumatic dry sorbent truck unloading system and silo will be installed for the DSI system. Hydrated lime will be received by truck and pneumatically conveyed to a storage silo. Other than SCR installation, Units 4 and 5 would continue operating as they have historically. These operations are described in the following sections.

EPA Federal Implementation Plan for Best Available Retrofit Technology (Post-2014)

In August 2012, the EPA published its source-specific FIP for BART to achieve emissions reductions required by the Clean Air Act at FCPP (40 CFR 49.5512).[1] EPA has required FCPP to reduce emissions of NO_x. EPA has also set emission limits for particulate matter, based on emission rates already achieved at FCPP, which contributes to visibility impairment in 16 mandatory Class I federal areas around FCPP.

The final FIP allows APS to choose between two BART options:

- Shut down Units 1, 2, and 3 by January 1, 2014, and install and operate SCR devices on Units 4 and 5 to comply with a BART emission limit of 0.098 lb/MMBtu of heat input by July 31, 2018; or
- Retrofit all five units to comply with a plantwide BART emission limit of 0.11 lb/MMBtu of NO_x by installing and operating an SCR device on one 750-MW unit by October 23, 2016, and installing and operating SCR control technology on the remaining four units by October 23, 2017.

The final BART FIP rule also stipulates that Units 4 and 5 must meet a particulate matter emission limit of 0.015 lb/MMBtu within 60 days after the restart of the units following the major scheduled outages in 2013 and 2014. These emission limits will be attainable though proper operation of the existing baghouses. FCPP must continue to meet the 20 percent opacity limit on Units 4 and 5 as well as on its materials and coal handling operations.

Actions to Comply with BART Ruling

The FIP for BART at FCPP required APS to notify EPA of its choice of BART compliance option by July 1, 2013. EPA subsequently extended the date by which APS must notify EPA of its BART compliance strategy, from July 1, to December 31, 2013. APS notified EPA of its selection of the first option and shut down Units 1, 2, and 3 on December 30, 2013.

APS also began planning for the installation of SCR on Units 4 and 5. Between 2014 through July 2018 (when SCR devices must be installed and operational), the FCPP would operate only Units 4 and 5 as they have historically, as described above. After July 2018, APS would operate Units 4 and 5 with SCR installed. These actions are described more fully below.

[1] http://www.gpo.gov/fdsys/pkg/CFR-2012-title40-vol1/pdf/CFR-2012-title40-vol1-sec49-5512.pdf

Shutdown of Units 1 Through 3

APS shut down Units 1, 2, and 3 on December 30, 2013, as required by FIP. Following shutdown, the units will be decommissioned. Between February 2014 and February 2015 high value equipment including pumps, motors, and transformers will be removed and marketed for sale. Smaller equipment will also be removed and decommissioned. Decommissioning of larger components such as tanks, heaters, and scrubbers will begin in February 2015 and is projected to take approximately 1 year. Demolition of structures, such as the buildings and the units, is anticipated to begin in February 2016. Structures supporting Units 4 and 5 will remain, as well as other structures required by the lease. Decommissioning and dismantling activities will be coordinated with the Navajo Nation, in accordance with lease requirements, so that the area meets the specific needs of any planned reuse. APS has not yet prepared a final decommissioning plan, but any demolition activities would comply with all environmental laws and regulations applicable at the time of decommissioning.

Decommissioning would require environmental abatement activities in the power block, including removal of environmental and safety hazards (e.g., asbestos, lead paint), and chemicals and oils. All chemicals and hydrocarbons will be managed by employees or contractors with the appropriate skill and training to deal with the specific associated hazard and removed and disposed of according to environmental regulations. Clean Harbors will recycle used oil and dispose of hazardous waste in their approved facilities. Clean Harbors will also recycle universal waste . Lead paint on metal will either be recycled or removed and disposed as hazardous waste. Asbestos will be removed by certified asbestos workers and sent to a Waste Management-approved facility by Joseph City, Arizona. Chemicals, oils, and hazardous materials will be removed shortly after Unit shutdown. Asbestos will be removed over time to maintain safety or when equipment and structures are removed or demolished. All waste generated during this phase would be managed and disposed of in accordance with applicable federal environmental regulations. Dismantling and demolition would commence following the removal of asbestos, polychlorinated biphenyls, lead paint, and any other hazardous chemicals. Upon removal of structures and facilities, the structural foundations would be removed to 24 inches below grade, the site profiled to allow for proper drainage, and native vegetation planted. The timeline for this process is at APS' discretion.

Installation of SCR Equipment on Units 4 and 5

APS will install SCR air emission control devices on Units 4 and 5. SCR systems could be installed at two locations at the FCPP: (1) upstream of both the secondary air preheater and baghouse (hot-side, high-dust) and (2) downstream of the secondary air preheater and baghouse (cold-side, low-dust). APS has elected to install hot-side, high-dust SCRs between the boiler economizer and secondary air preheater on Units 4 and 5. This location is preferred because it eliminates the need to reheat the flue gas to reaction temperature, thereby minimizing loss of thermal efficiency. Each SCR would have two reactors, and each reactor would contain three layers of catalyst and a cavity for a future catalyst layer. After the first 3 years, the top degraded layer would be replaced with the next lower layer. A contract would be set up with the catalyst supplier to handle the spent catalyst.

Ammonia, a required component in the operation of SCR controls, would be transported to the FCPP and stored on site. Ammonia would be supplied to the FCPP by a reagent processing plant, which has yet to be identified. Ammonia would be transported by truck from the nearest large metropolitan area that has the capability to manufacture the required form of ammonia. The three types of ammonia source being considered by APS are anhydrous ammonia, aqueous ammonia (29 percent by weight), and solid urea-derived. The approximate number and size of tanks, footprint area, and an estimate of the number of truck shipments per year are shown for the three ammonia options in Table 2-8.

Table 2-8 Ammonia Reagent Options

Option	Number of Tanks*	Footprint Area (square feet)	Product Amount per Year (tons)	Number of Shipment Trucks per Year
Anhydrous Ammonia	2 rows of 4 (8 total)	39,000 (tanks, unloading and pumping equipment)	9,966	643 (12 per week)
29.4% Aqueous Ammonia	3 rows of 6 (18 total)	57,000 (tanks, unloading and pumping equipment)	33,797	1,504 (29 per week)
56.7% Dry Urea Pellets	3 rows of 6 (18 total)	67,000 (tanks, unloading, pumping, and hydrolyzing equipment,)	17,534	874 (17 per week)

Tanks would be horizontal 10-foot diameter by 40-foot length, 20,000-gallons (useable volume).

The environmental issues associated with the different alternatives for transporting, storing, and using ammonia are analyzed in detail as part of continuing operations of the FCPP in Section 4.15.2.1 of the Draft EIS (OSMRE 2014). OSMRE recommends the use of urea, owing to the much greater transport safety.

A pneumatic dry sorbent truck unloading system and silo will be installed for the DSI system. Hydrated lime will be received by truck and pneumatically conveyed to a storage silo. The silo will have a baghouse for emissions control. The lime silo will be approximately 14 feet in diameter and 80 feet tall, including lime transport equipment beneath the silo. Truck traffic will increase due to the delivery of hydrated lime for the DSI system, but will occur on paved roads that have varying levels of existing traffic. Approximately 17 trucks per week (900 trucks per year) delivering 10,800 tons per year of hydrated lime are projected to be used.

Contract labor and equipment would be mobilized for pre-outage and tie-in outage construction activities. Pre-outage construction is expected to last for approximately 19 months and would require approximately 300 workers. Final tie-in outage construction is expected to last for approximately 105 days and would require approximately 450 workers. Equipment used during construction is expected to include one tower crane, two 250- to 300-ton cranes, and four 60- to 90-ton cranes.

Although the BART rules specifically address NO_x and particulate matter, the BART option chosen by APS would result in a decrease of all air pollutants emitted as shown in Table 2-9. These reductions are expected to provide a substantial benefit to the local environment.

Table 2-9 Summary Comparison of Historic and Future Emission Rates

Criteria Pollutants, Greenhouse Gases and Target Metals	Historic Baseline Emissions Units 1, 2, 3, 4, 5 (tons/yr)	Estimated Future Emissions Units 4 and 5 (tons/yr)	Future versus Historic Baseline (Reduction percent)
Sulfur Dioxide (SO_2)	11,971	9,800	18%
Nitrogen Oxides (NO_X)	41,121	5,420	87%
Carbon Monoxide (CO)	2,096	1,580	25%
Filterable Particulate Matter	1,976	830	58%
CO_2 Equivalents (CO_2e)	15,439,236	11,396,710	26%
Arsenic (As)	1.78	0.06	96%
Lead (Pb)	1.82	0.07	96%
Mercury (Hg)	0.36	0.07	81%
Selenium (Se)	5.63	0.28	95%

Sources: EPA 2011,; 2012a, 2012b, 2012c, 2012d; AECOM 2013a; 40 CFR 63 Subpart UUUUU Table 2

Notes:

Baseline period is 2005-11 (flue gas desulfurization [FGD] installed on Units 4 and 5)

Estimated future Unit 4 and 5 emissions for 2019 and beyond (SCR operated pursuant to 40 CFR 49.5512 BART rule)

Future maximum annual capacity factor = 92% based on historic operations (average historic annual capacity factor = 84%, generation basis)

Modeled emission rates based on 7,411 mmBTU/hr heat input each unit and selected emission factors (AECOM 2013a)

Estimated future SO_2 emissions based on Part 75 annual data; Modeled SO_2 based on Part 75 1-hour average value (AECOM 2013a)

Estimated future NO_X emissions based on Part 75 annual data and BART Rule; Modeled NO_X based on BART Rule 30-day rolling average (AECOM 2013a)

Reduction with respect to historic plantwide baseline for all 5 units operating

Historic baseline and estimated future particulate matter emissions calculated pursuant to AP-42 Chapter 1.1 support document Tables 4-7 and A-3; Title V permit condition (Units 1, 2, 3); 40 CFR 49.5512 (Units 4 and 5); CO calculated per AP-42 Chapter 1.1 Table 1.1-3

2.5.2.3 Power Plant and Mine Water Supply

All of the water supply for the plant is obtained from the San Juan River. Water is pumped from the river to Morgan Lake, and then pumped from the lake into the plant for use. An average of 27,682 acre-feet of water is pumped from the San Juan River to Morgan Lake annually. BBNMC holds the water rights made available to FCPP and Navajo Mine for all water use related to the Proposed Action (New Mexico Office of State Engineer Permit No. 2838).

The intake structure on the river consists of two 10- by 10-foot intake bays, placed perpendicularly to the flow of the river. These intake bays are located just upstream of the APS Weir. The weir includes a control gate that provides the ability to control water depths at the intake location. The intakes are screens with an approximately 1-inch by 3-inch opening. Approach velocities toward the screens are 0.38 foot per second. No fish collection or return facilities are associated with the intake (R. Grimes, pers. comm., 2014).

The intakes are operated in two modes, pumping either 17,000 gallons per minute (gpm) or 32,000 gpm (approximately 37 and 71 cubic feet per second [cfs], respectively) from the San Juan River. The intake is operated at any time of day, as needed. The 17,000-gpm mode is generally used during the October to May timeframe, and the 32,000-gpm mode is generally used during the May through October timeframe. This diversion rate is driven primarily by the evaporation rate of Morgan Lake. These pumps run approximately 80 percent of the time. The 17,000-gpm mode is through one 10- by 10-foot screen and the 32,000-gpm mode is 16,000 gpm each, through both 10- by 10-foot screens. These intakes were installed pursuant to the FCPP lease. The APS Weir does not include a fish passage structure (R. Grimes, pers. comm., 2014).

FCPP uses water for a variety of purposes, including SO_2 scrubbing, steam condenser cooling water, and air compressor and other equipment cooling water, dust control, washwater for vehicles and facilities, and domestic purposes. Units 4 and 5 together use approximately 5,000 af/yr for operation of the SO_2 scrubbers. Units 4 and 5 evaporate approximately 13,000 af/yr of cooling water. The average annual water consumption between 2000 and 2011 was 22,856 af/yr. FCPP and BBNMC, for purposes of water supply to Navajo Mine, have an agreement through 2017 with Jicarilla Apache Nation for supplemental water, if required, during periods of drought when a full supply under Permit 2838 may not be available.

Discharge from the power plant to Morgan Lake from the condenser cooling water discharge canal is approximately 105 degrees Fahrenheit (°F). Cooling water from the main condensers and other equipment condensers is discharged to the condenser cooling water discharge canal that flows into Morgan Lake. The lake's water temperature ranges from 65 to 90°F depending on the time of the year. Between 2000 and 2011, approximately 4,826 af/yr were discharged from Morgan Lake to No Name Wash, which flows to Chaco River, an intermittent wash that terminates at the San Juan River, approximately 5 miles northwest of the plant. No groundwater is used at FCPP.

2.5.2.4 Capacity Factor

Capacity factor is defined as actual utilization of the power-producing units, divided by their full load capacity. For generating units, this factor is typically expressed as actual megawatt-hours (MW-hrs) generated in a year versus design rating in megawatts times 8,760 hours per year (maximum theoretical MW-hrs). Since generating units must be periodically shut down for routine maintenance, repair, and replacement, capacity factor is always less than 100 percent, typically in the range of 80 to 95 percent for base load generating units, depending on overall reliability. Historic annual average capacity factor at FCPP is 86 percent.

2.5.2.5 Ash Production

Ash produced in the combustion process consists of bottom ash and fly ash (also known as CCRs). Bottom ash accumulates along the inside walls and floors of the boiler units. The bottom ash inside the boiler is directed to the bottom ash hopper. The total production rate of furnace bottom ash for Units 4 and 5 is approximately 40 tons per hour during full load conditions. The furnace bottom ash is collected and removed by means of a hydraulic-vacuum system and delivered via sluice water pipelines to dewatering bins. In the bins, the sluice water is decanted and the bottom ash is unloaded to trucks for disposal. Two dewatering bins are each 35 feet in diameter with a storage capacity of approximately 21,600 cubic feet, or 400 tons, with a bottom ash density of 37 pounds per cubic foot. Each bin is elevated for 20-foot truck clearance, with trucks periodically hauling the ash from the dewatering bins to the DFADA or to construction sites for the buttresses of the dams and access roads.

Fly ash constitutes approximately 80 percent of the FCPP's total ash output. Fly ash is produced by Units 4 and 5 at a total rate of approximately 150 tons per hour during full load conditions. The fly ash from the boiler passes through the flue gas draft system to the fabric filter dust collectors ("baghouses"), which remove fly ash from the flue gas. A fly ash handling system then removes the fly ash from the baghouse hoppers and conveys it to silos for storage. The ash is mixed with scrubber process water for dust control and to aid in compaction. Trucks then transport the dry fly ash (no free liquid) to a lined DFADA on site for disposal. The baghouse system for Units 4 and 5 is designed to remove not less than 99.87 percent of fly ash from the flue gas.

2.5.2.5.1 On-Site Ash/Flue Gas Desulfurization Disposal System

The FCPP has disposed of fly ash and bottom ash since 1962 and FGD waste since 1979, when the Venturi particulate scrubbers on Units 1, 2, and 3 were retrofitted to remove SO_2.

Units 1, 2, and 3 ash/FGD waste slurry historically was sluiced to impoundments in the Ash Disposal Area located approximately 1 mile west of the power plant. Prior to 2008, ash and FGD wastes generated by Units 4 and 5 were hauled to the adjacent mine for disposal in mined-out areas regulated by the OSMRE. Since 2008, fly ash generated by Units 4 and 5 has been trucked to a lined DFADA located on-site. The DFADA is separate from the historic Ash Disposal Area described above and is located immediately south of it (Figure 2-5). Bottom ash is also trucked to the DFADA. A portion of the fly ash is also sold for beneficial reuse. FGD slurry from Units 4 and 5 scrubbers is pumped to thickeners. The thickeners underflow is pumped to the LAI in the Ash Disposal Area where the solids settle and the liquid is decanted to the Lined Water Impoundment. The liquid is pumped back to the scrubbers for reuse. From 1962 to the present, approximately 33.5 million tons, or 20,800 acre-feet, of fly ash, bottom ash, and FGD solids have been placed into the Ash Disposal Area.

2.5.2.5.2 Description of Ash Disposal Facilities

The Ash Disposal Area currently consists of the following facilities (Figure 2-5), each of which is described in detail below:

- Ash Ponds 1 and 2/Evaporation Ponds 1 through 4
- Ash Pond 3/Lined Decant Water Pond (LDWP)
- Ash Ponds 4 and 5/LAI
- Ash Pond 6
- DFADA Sites 1 and 2
- Gridded Disposal Area

Ash Ponds 1 and 2 and Evaporation Ponds 1 Through 4

Ash Ponds 1 and 2 were constructed in the 1960s by erecting a dike on existing ground downstream from the power plant. Ash slurry was allowed to flow through existing washes until it was captured by the dike. The ash ponds were not lined and contain an average depth of approximately 24 feet of ash. Ash Ponds 1 and 2 were taken out of service when Ash Pond 3 was constructed in 1976.

In the late 1970s, Evaporation Ponds 1 through 4 were constructed on top of Ash Ponds 1 and 2. The evaporation ponds were constructed with a single liner of 20 mL high-density polyethylene (HDPE) and a 1-foot layer of earth and gravel fill placed over the liner on the sides of the ponds. The evaporation ponds were used for storage of seepage intercept water, runoff, and other industrial water from the FCPP. FCPP began phasing out the use of the evaporation ponds in 2001. The evaporation ponds have not been in use since October 2011 and have since been reclaimed.

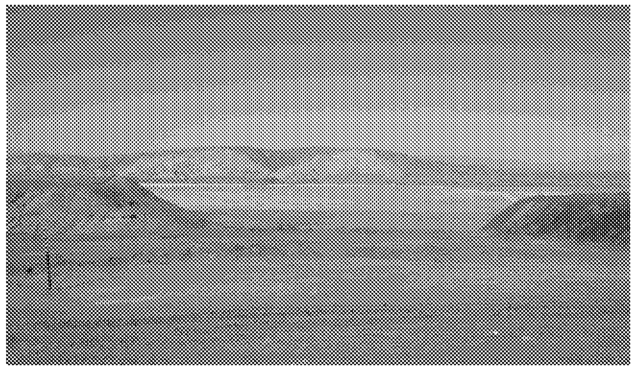
Ash Pond 3 and Lined Decant Water Pond

Ash Pond 3 is currently inactive and was used as an impoundment for the fly ash and FGD solids from Units 1, 2, and 3. The west embankment of Ash Pond 3 is the tallest of all embankments surrounding the pond, approximately 80 feet higher than natural grade.

The LDWP was constructed on top of the western and southern embankments of Ash Pond 3 and is intended to collect and retain liquid decanted from the LAI (described below). The LDWP is lined with two layers of HDPE Geosynthetic liner, each 60 mL thick. The liquid collected in the LDWP is then pumped back to the plant for reuse in the scrubbers.

Ash Ponds 4 and 5 and Lined Ash Impoundment

Ash Pond 4 was constructed adjacent to and shares its western embankment with Ash Pond 3. The western embankment of Ash Pond 4 is the tallest of all embankments surrounding Ash Pond 4, approximately 40 feet higher than natural grade. Ash Pond 5 was constructed adjacent to and shares its southwestern embankment with Ash Pond 4. The northwestern embankment of Ash Pond 5 is the tallest of all embankments surrounding Ash Pond 5, approximately 70 feet higher than the natural grade. Ash Ponds 4 and 5 are inactive and were used as impoundments for the fly ash and FGD solids from Units 1, 2, and 3.


Photograph of the Lined Ash Impoundment at FCPP

Construction of the LAI began in 2003. It was built in five lifts over the top of Ash Ponds 4 and 5 and is lined with a single 60-mL HDPE liner. The LAI is being used to impound the fly ash from Units 1 through 3 and FGD solids from all five units at the FCPP. Once the solids settle in the LAI, the liquids decant into the LDWP through either an outfall structure located on the downstream end of the LAI or are pumped through an 8-inch-diameter HDPE drain pipe located in the southwestern corner of the LAI. Once the liquid has been pumped or gravity fed into the LDWP, it is then pumped back into the plant for reuse in the scrubbers.

Ash Pond 6

Ash Pond 6, which is located on the northwestern side of the Ash Disposal Area, is currently inactive, but was used to impound the fly ash and FGD solids from Units 1, 2, and 3. Ash Pond 6 was designed in 1984 and constructed shortly thereafter. Ash Pond 6 borders Ash Pond 3 to the south and Ash Pond 5 to the southeast. The northern embankment of Ash Pond 6 is adjacent and parallel to the northern lease boundary of the site. Ash Pond 6 is constructed with a clay core embankment that has been keyed into the unweathered shale bedrock. The final lift of Ash Pond 6 is approximately 80 feet higher than natural grade on the western embankment.

Dry Fly Ash Disposal Area Sites 1 and 2

The DFADA is currently an active, lined landfill facility originally constructed in 2007 and is used for disposal of dry fly ash from Units 4 and 5, as well as small amounts of construction debris from the FCPP. DFADA Site 1 is tallest on its western berm at approximately 110 feet above natural grade. Both DFADA Sites 1 and 2 have composite liner systems consisting of compacted clay liner and a 60-mL HDPE liner. Both sites are projected to reach capacity by 2016.

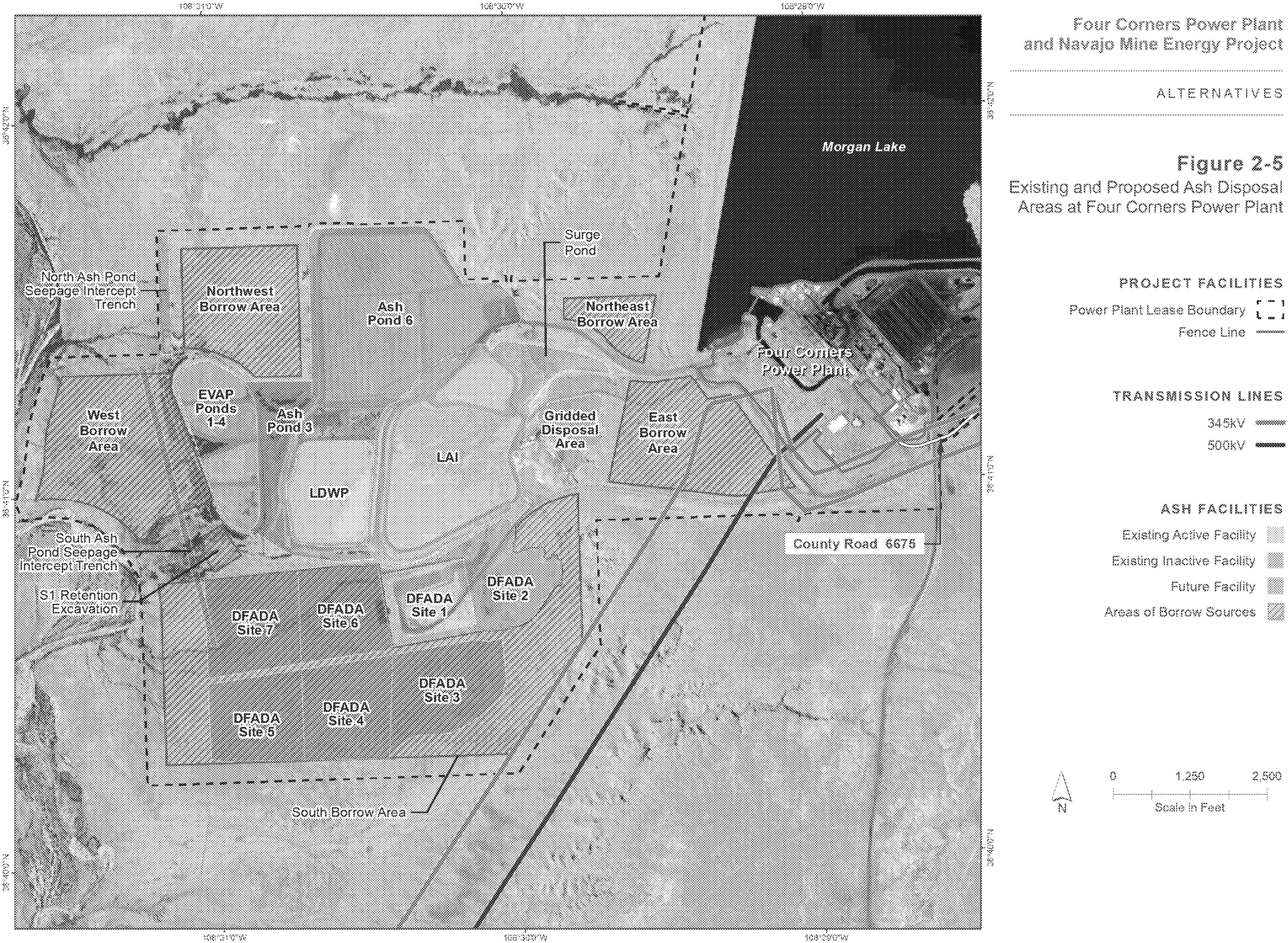
Gridded Disposal Area

The gridded disposal area, located east of and adjacent to the LAI, received coal dust and ash from plant cleanup, lime grit, and construction and other industrial debris until 2010. Asbestos-containing materials were formerly disposed in trenches dug in that waste. Asbestos disposal in the gridded disposal area was discontinued in 1997. In 1984, a portion of the gridded disposal area was used to land farm oil/solvent-contaminated soil (known as the former chlorinated hydrocarbon disposal area). This area is located immediately north of the asbestos disposal area. A thin layer of the contaminated soil was applied to the area to allow air contact, volatilizing the solvents from the soil. The soil was sampled and tested to ensure that residual solvent concentrations were at acceptable levels and then stabilized by applying a covering of ash. The New Mexico Environmental Improvement Division, who inspected the site, took samples, and approved closure of the remedial activity, approved this remediation plan.

Four Corners Power Plant
and Navajo Mine Energy Project

ALTERNATIVES

Figure 2-5
Existing and Proposed Ash Disposal
Areas at Four Corners Power Plant



2.5.2.5.3 Beneficial Reuse of Fly Ash

In 1997, a vendor established a fly ash beneficiation facility at the FCPP, which allows APS to sell fly ash to other companies to be reused in other materials, such as concrete. An average of 240,000 tons per year of the fly ash is beneficially used, which represents approximately 20 percent of the total fly ash generated. The FCPP has beneficially used (recycled) more than 3.5 million tons (7 billion pounds) of fly ash since 1997, thereby reducing (i) the amount of fly ash that must be stored at the site, (ii) the reusers' need for virgin materials and the energy required to acquire them, and (iii) greenhouse gas emissions. Fly ash from the FCPP is used as an ingredient in concrete for the construction of dams, streets, freeways, bridges, buildings, sidewalks, driveways, parking structures, concrete blocks, and roof tiles.

2.5.2.5.4 Changes to Coal Combustion Residue Management

Ash waste generated from Units 4 and 5 would continue to be placed in DFADA Sites 1 and 2 until these sites reach capacity. Unit 4 and 5 FGD waste will continue to be pumped to the LAI until it reaches capacity or new regulatory requirements dictate that it be discontinued. Subsequently, APS plans to mix FGD waste with ash and dispose of it in a DFADA. APS would construct as many as six additional DFADAs to accommodate future disposal of all fly ash, bottom ash, and FGD waste generated through the duration of the lease term. Each site is anticipated to be approximately 60 acres and approximately 120 feet high (Table 2-10). Estimated annual storage volumes would be 1,118 af/yr. Each site is anticipated to be in operation for 5 years. Once the storage capacity of each site is met, FCPP would close the facility using an evapotranspiration cover. The evapotranspiration cover would include a layer consisting of finer-grained sands, silts, and clay soils and an erosion layer consisting of soil and rock mixture. The material for the cover would be borrowed from five areas inside the existing FCPP Lease Area. The amount of borrow required for closing the dry fly ash disposal sites was determined using topographic data and assumed final slopes of the closed areas. Based on these calculations, approximately 6.6 million cubic yards of borrow is available within the FCPP Lease Area and 4.8 million cubic yards would be required for closure. As closure would be conducted at the end of each site operation, in some instance, material would be borrowed from a DFADA construction site to cap existing, full capacity disposal sites. In addition to the five new sites, a surge pond (lined impoundment) would be constructed to capture generated FGD waste and historic ash impoundment seepage intercept water. All soil for impoundments and berms surrounding the impoundment would be borrowed from one of the five areas inside the existing FCPP Lease Area (Figure 2-5).

Table 2-10 Summary of Ground Disturbance Area at FCPP

Dry Fly Ash Disposal Areas	Area (acres)
DFADA 1	39
DFADA 2	34
DFADA 3A	28
DFADA 3	51
DFADA 4	61
DFADA 5	63
DFADA 6	41
DFADA 7	68
Total	385
Borrow Pit Areas	**Area (acres)**
East Borrow Area	91
Northeast Borrow Area	23

Dry Fly Ash Disposal Areas	Area (acres)
Northwest Borrow Area	83
S1 Retention Excavation	6
South Borrow Area*	407
West Borrow Area	121
Total	731

*Approximately 32 acres of overlap between the south borrow area and the DFADAs, resulting in a total disturbance acreage of 1,052 acres.

2.5.2.6 *Chemical Storage*

The only chemical stored and used at the FCPP that is classified by EPA as an Extremely Hazardous Substance is sulfuric acid. Other chemicals are used and stored in much smaller volumes throughout the facility in the form of spray cans and other small containers.

2.5.2.7 *Switchyards*

A switchyard is a system of breakers, disconnects, and transformers, with voltage reactors and capacitor banks. The switchyards take the power generated by the FCPP and distribute the power through the equipment in the switchyard and the high-voltage transmission lines to load centers. Power from other generating sources, such as San Juan Generating Station and other power plants, is also wheeled through the switchyards (i.e., passed through and not related to FCPP operations). The FCPP has three switchyards, all of which are contained within the plant site lease area. All switchyards are secured with a 7-foot-high chain-link fence with three strands of barbed wire surrounding its perimeter. Entrance gates are locked at all times when unattended.

The operational performance of all three switchyards' oil-filled electrical equipment primarily is monitored remotely by APS in Phoenix. The power plant's control room monitors specific electrical equipment designated for the units. Substantial changes in the equipment's operating condition trigger an alarm indicating an adverse condition. This alarm prompts on-site investigation by APS personnel. Oil-filled equipment is monitored by APS and designed with several fail-safe engineering controls to prevent faulting. All oil-filled equipment is situated within secondary containment and all switchyards have 4 to 6 inches of gravel placed throughout to prevent accidental discharge to the surrounding environment should the primary containment fail.

2.5.3 Transmission Lines

Several existing transmission lines owned and operated by APS or PNM and directly associated with the FCPP require ROW renewals within the period of time of the Proposed Action. No new transmission lines would be developed as a Project component. However, the potential environmental effects from the continued operations of the transmission lines are analyzed in this BA. These transmission lines are listed below and shown on Figure 2-1:

- *APS FCPP to Moenkopi Substation.* Navajo and Hopi ROWs expire December 2016 and March 2017, respectively. This line was formerly used to transmit electricity from the FCPP to the Southern California Edison service territory. Southern California Edison divested its share of the FCPP and no longer imports power from FCPP to California. APS no longer uses the transmission line west of Moenkopi to transmit power from the FCPP to the Southern California Edison service territory. The line would be used to bring power into APS' service territory; this cannot proceed unless the FCPP continues operation. At the request of APS, the transmission line segment from Moenkopi Substation to the Navajo Nation boundary is also included.

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- *APS FCPP to Cholla Substation.* The Navajo ROW for this transmission line expired in May 2011. The BLM lease for the portion of the line from the Navajo Nation boundary to Cholla Substation was renewed in 2012, with the term extending to 2041. Therefore, the Proposed Action includes only the renewal of the ROW for the portion of the line from FCPP to the Navajo Nation boundary: 86 percent of the use of this line is to transport FCPP electricity to APS customers. The remaining 14 percent use of this line is for other utilities besides FCPP.
- *PNM FCPP to West Mesa Switchyard.* The Navajo ROW for this transmission line expires in June 2018. Another former BLM ROW conveyed to the Navajo Nation in 1994 and to Zia Pueblo in 2013 expires in May 2016.
- *PNM FCPP to San Juan Switchyard.* The Navajo ROW for the 4.5-mile portion of the line on the Navajo Nation expires in August 2015. The line is used to transmit FCPP electricity to PNM customers and between FCPP and the PNM San Juan Generating Station.

Operations and maintenance of the transmission lines are described in the following two sections. No transmission or access road construction is anticipated as part of the Project, and no changes to the existing ROW would occur.

2.5.3.1 APS Transmission Lines

2.5.3.1.1 Current Operations

The transmission line ROW grants issued to APS by the BIA and associated with the FCPP apply to the following:

- 179 miles of 500-kV transmission line from the FCPP Switchyard to Moenkopi Substation (ROW encompasses approximately 4,339 acres) over both Navajo Nation and Hopi Tribal Trust Lands (El Dorado line)
- 14 miles of 500-kV transmission line from Moenkopi Substation to the Navajo Nation boundary (ROW encompasses approximately 338 acres)
- Moenkopi Substation (20-acre switchyard footprint within a 212-acre ROW boundary)
- Moenkopi Substation 12-kV line and Access Road (ROW encompasses approximately 0.992 acre)
- 179 miles of FCPP to Cholla 345-kV transmission lines from the FCPP Switchyard to the boundary of the Navajo Nation (two adjacent circuits with a ROW encompassing approximately 5,633 acres). This transmission line runs parallel in one 315-foot ROW corridor for 85.7 miles, then separate into two 195-foot corridors (one is 41.9 miles and the other is 41.1 miles), then converge again into a single 315-foot corridor for 10.7 miles before leaving Navajo lands.

APS owns and operates the FCPP to El Dorado 500-kV line, which includes Moenkopi Substation, and the 345-kV transmission lines. The 345-kV transmission lines were constructed in 1961, and the 500-kV line was constructed in 1966. Both the 500-kV and 345-kV transmission line towers are typically steel lattice towers that range in height from between 80 to 150 feet, with cross arm widths ranging from approximately 40 to 110 feet (Figure 2-6).

2.5.3.1.2 Right-of-Way Access

Access to the transmission line ROW is achieved exclusively through the use of public roads; neither APS nor PNM hold easements or access rights outside the transmission line ROW. Access to the transmission line ROW is generally open to the public unless access is restricted by the landowner; APS and PNM do not restrict access to the transmission line ROWs. In the ROW, access to the lines and towers is generally achieved through the use of unpaved roads.

In the ROW, access to the lines and towers is generally achieved through the use of unpaved roads. APS and PNM do not perform regularly scheduled maintenance on roads within the ROWs.

Moenkopi Substation

The 500-kV Moenkopi Substation and associated 12-kV line and access road are located at 457 North Highway 89 in Coconino County, Arizona. APS is the owner/operator of Moenkopi Substation with several other entities having transmission rights through the switchyard.

The ROW for the switchyard is 212 acres; the fenced switchyard occupies only 20 acres of the ROW area. The switchyard has a 7-foot-high chain-link fence with 3 strands of barbed wire surrounding its perimeter. Entrance gates are locked at all times when unattended.

The switchyard provides an electricity grid interconnection point between four 500-kV transmission lines, including the Four Corners to Moenkopi line, the Navajo Generating Station to Moenkopi line, the Moenkopi to El Dorado Substation line, and the Moenkopi to Yavapai Substation line. The interconnection at Moenkopi Substation permits APS to transfer FCPP power south to the Phoenix load center. A 12-kV line provides station power to Moenkopi Substation; if this line fails, APS has an on-site generator for backup power. Moenkopi Substation contains capacitor banks and reactors to balance the transmission lines.

The operational performance of the switchyard's oil-filled electrical equipment is monitored remotely by APS in Phoenix. Any substantial change in the equipment's operating condition can trigger an alarm indicating an adverse condition. This alarm will prompt an on-site investigation by APS personnel. Oil-filled equipment that is monitored by APS is designed with several fail-safe engineering controls to prevent faulting.

Moenkopi Substation contains a control house with remote monitoring equipment, a storage building for spare parts and equipment, and a 1,000-gallon aboveground concrete tank to store diesel fuel. Mineral oil-filled electrical equipment includes 6 current transformers and 15 shunt reactors. The maximum amount of oil contained in all of this equipment is 126,871 gallons; the largest piece of oil-containing equipment is a shunt reactor with a 15,189-gallon capacity.

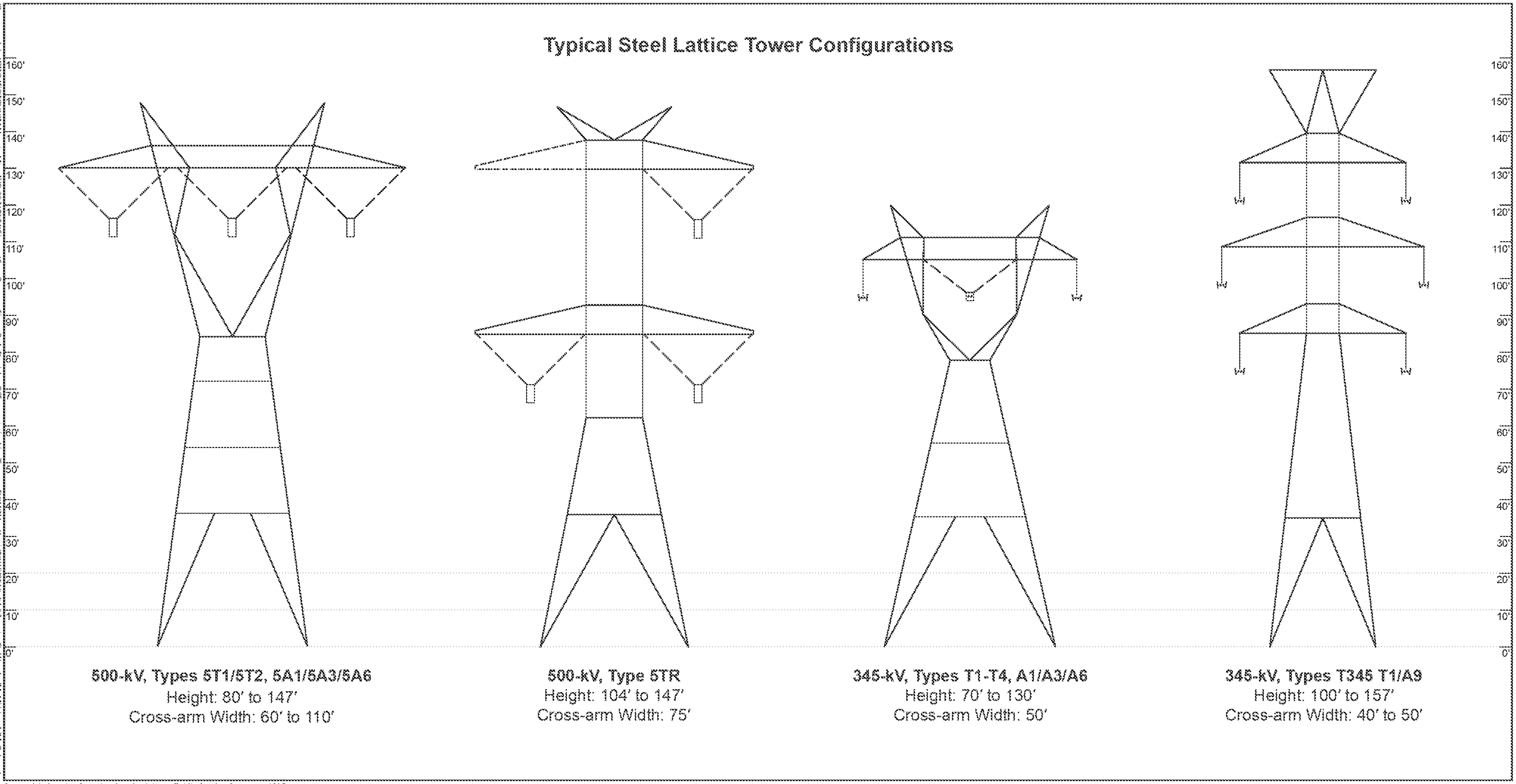
Moenkopi Substation uses either secondary containment (concrete berms) or 4 to 6 inches of gravel fill to prevent any discharge of oil beyond property boundaries.

2.5.3.1.3 Ongoing Maintenance Activities

APS conducts yearly inspections of each structure on each transmission line and conducts maintenance as needed. Visual and physical inspections may include vehicle (passenger and all-terrain vehicle), pedestrian, and aerial surveys. APS performs climbing inspections every 7 years, which involve a close visual inspection of each transmission line.

During ground surveys, inspectors utilize existing access roads. These access roads are maintained by the local landowner for the APS ROWs and APS does not conduct regular road maintenance activities. Access roads are primarily unimproved two-track dirt roads. Access roads are repaired when they become impassable for maintenance activities. Access roads may also be managed to control erosion and reduce conditions that cause excessive rutting. Maintenance for the transmission line structures may include re-leveling pads in areas of uneven terrain to permit safe equipment setup, repair, replacement, or addition of structures or any of the associated equipment and wires, and treating the structures to prevent rot and extend their life span.

Figure 2-6
Depiction of APS Transmission Line Towers



Source(s): Adapted from drawings by Arizona Public Service Company, 1965.

APS has an environmental screening program that requires screening all transmission maintenance work for compliance-related environmental issues. The environmental review relies on end-to-end biological and cultural surveys of the ROW corridors. Ground-disturbing work in the vicinity of a known cultural or biological resource requires specific monitoring or avoidance stipulations and procedures, and land managing agencies are consulted to determine the best course of action to protect the integrity of the resource while conducting the necessary maintenance. Emergency conditions (e.g., weather, system outages, and structure damage) are addressed immediately.

Vegetation management at APS involves the cyclical treatment of vegetation approximately every 5 to 10 years utilizing mechanical, manual, and herbicide treatments. Vegetation may be cleared within the entire permitted ROW width, including clearing around poles, guy wires, anchors and towers. On rare occasions vegetation maintenance outside the routine cycle is required to address emergencies or imminent threats to the transmission line's performance. Vegetation maintenance activities are sensitive to resource (cultural) and plant and animal species concerns. APS conducts aerial helicopter patrols of the transmission lines 1 to 3 times per year to identify potential problem areas, to plan maintenance schedules and to monitor effectiveness of treatment. Ground patrols may be required to follow up on any identified problem areas.

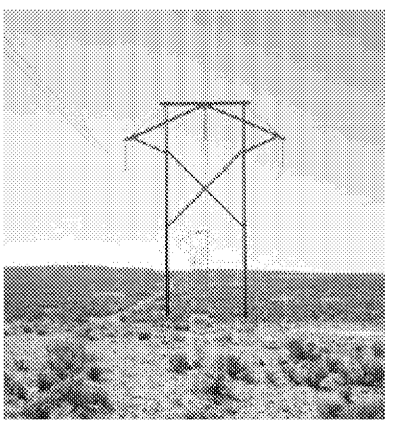
2.5.3.2 PNM Transmission Lines

2.5.3.2.1 Current Operations

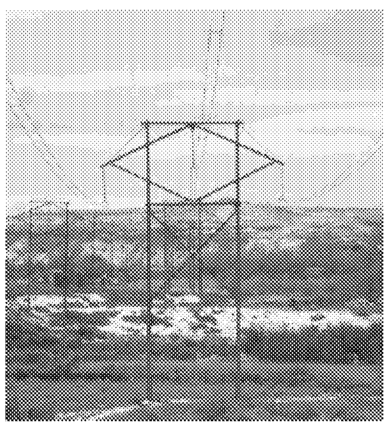
PNM is part owner of and operates the Four Corners-San Juan and Four Corners-West Mesa transmission lines. The transmission lines enable PNM to deliver output from the FCPP and other electrical generating sources in several western states. The lines are essential elements of the Bulk Electric system reliability for both PNM and network customers. Both are 345-kV transmission lines with 100-foot-wide ROWs. The Four Corners-West Mesa transmission line extends approximately 156 miles, and the Four Corners-San Juan transmission line is approximately 10 miles.

Power can flow in either direction depending on the demand and the generation availability. Any rights to transact in or out of Four Corners Switchyard on these transmission lines are governed by existing open access transmission tariff or bilateral transmission service agreements. Because of the convergence of a substantial high-voltage transmission network at Four Corners Switchyard, the various parties who do business there are able to enter into both sale and purchase transactions, enabling efficient use of generation for both conventional and renewable resources.

The transmission line towers are wooden K-Frames. Photos of the types of structures are provided below.



Four Corners-West Mesa Transmission Tower



Four Corners-San Juan Transmission Tower

2.5.3.2.2 Right-of-Way Access

The transmission lines traverse multiple land jurisdictions and each has multiple grants of ROW agreements and easements. The FCPP to San Juan line traverses Navajo Nation, BLM, State Land Office, and private land. The FCPP to West Mesa transmission line crosses noncontiguous BLM land, Navajo and allotted land, Petroglyph National Monument (the transmission line predates the creation of the national monument), private land, State Land Office, and Zia Pueblo land. In October 2010, the Navajo Nation Council approved the ROW Extension/Renewal Agreement between the Navajo Nation and PNM, which provides for the continued operation and maintenance of these transmission lines, among other PNM transmission lines and facilities.

Access to the transmission line ROWs is generally open to the public unless access is restricted by the landowner; APS and PNM do not restrict access to the transmission line ROWs. In the ROWs, access to the lines and towers is generally achieved through the use of unpaved roads. APS and PNM do not perform regularly scheduled maintenance on roads within the ROWs.

2.5.3.2.3 Ongoing Maintenance Activities

PNM conducts yearly inspections of each structure on each transmission line and conducts maintenance as needed. Visual and physical inspections include vehicle (passenger and all-terrain vehicle), pedestrian, and aerial surveys. Vegetation management is conducted in accordance with the PNM Transmission Vegetation Management Plan and includes hand-cutting, mechanical clearing, and use of herbicides. Vegetation maintenance usually occurs every 4 to 5 years in pinyon-juniper and forested areas, and every 2 to 3 years in riparian areas. The PNM Transmission Vegetation Management Plan will be replaced by an updated document compliant with NERC CAC-003-3 requirements, which go into effect on July 1, 2014. Access roads are primarily unimproved two-track dirt roads. Access roads are repaired when roads and trails become impassable for maintenance activities. Access roads are also managed to control erosion and reduce conditions that will cause excessive rutting. Maintenance for the transmission line towers may include re-leveling pads in areas of uneven terrain to permit safe equipment setup, repair, replacement, or addition of structures or any of the associated equipment and wires, and treating the structures to prevent rot and extend their life span.

PNM also has an environmental screening program that requires screening all transmission maintenance work for compliance-related environmental issues. The environmental review relies on end-to-end biological and cultural surveys of the ROW corridors. Ground-disturbing work in the vicinity of a known cultural or biological resource requires specific monitoring or avoidance stipulations. Land managing agencies are consulted, as appropriate, to determine the best course of action to protect the integrity of the resource while conducting the necessary maintenance. Emergency conditions (e.g., weather, system outages, and structure damage) are addressed immediately.

2.6 Conservation Measures

2.6.1 <u>General Conservation Measures</u>

The Project Proponents have proposed many protective measures that would be implemented as part of the Proposed Action, including the ongoing implementation and adherence to numerous standard operating procedures and BMPs. Specific measures are required under the Proposed Action and the activities and standards contained in these measures are considered mandatory to the Proposed Action. The focus in this section is on those measures that provide specific benefit to listed species. A complete list of these measures is provided in Section 3.2.5 of the DEIS (OSMRE 2014).

2.6.1.1 Air Quality

As described in Section 2.5.2.2.1, the EPA FIP requiring BART at FCPP would lead to substantial reductions in the emission of air pollutants (Table 2-9). These beneficial reductions are analyzed as part of the environmental baseline because the EPA has completed its action and APS has committed to an option and begun its implementation. However, absent the retirement of Units 1, 2, and 3, the Proposed Action would not be proceeding in its current form.

2.6.1.1.1 Navajo Mine

Fugitive dust control measures at the Navajo Mine include the following:

- Unpaved haul roads and ancillary roads are watered with water trucks as needed to suppress dust.
- Heavily traveled portions of unpaved primary roads may be stabilized with chemical suppressants, or waters as needed to suppress dust.
- Haul roads are graded as necessary during hauling operations.
- High-use routes of travel in mining areas are graded as necessary.
- Maximum vehicle speed on paved and unpaved mine roads is limited to 45 mph within the permit area for all mine vehicles.
- Travel of unauthorized vehicles on other than established roads is restricted.
- The area of disturbed land is minimized, including the number and size of areas to be blasted at any one time.
- Curtains are installed around the drill stems on overburden drills. Water sprays and/or vacuum dust suppression systems are used to help suppress fugitive dust emissions when drilling overburden material.
- Regular inspections for coal fires are made throughout the mine area. If a coal fire ignites by spontaneous combustion, that portion of the coal is separated or buried to extinguish the fire where possible.
- Coal placed at the field coal stockpiles is smoothed and compacted as necessary to reduce spontaneous fires and fugitive dust, and allow the coal trucks to operate on the stockpile.
- Dust control during construction of a soil stockpile is done as needed by spraying the working area with water from a water truck. Inactive stockpiles will be mulched and/or seeded.
- Haulage vehicles are inspected regularly for proper function, which includes inspection of the haulage vehicle container body and, if necessary, repairs are conducted as soon as practicable.

2.6.1.2 Earth Resources

2.6.1.2.1 Navajo Mine

Topdressing Management

NTEC would implement Topdressing Management practices for the for topsoil replacement over the regraded spoil surface which will be used by MMCo on behalf of NTEC. OSMRE guidelines for reclamation programs and projects identify soil conditions that must be considered during reclamation, including soil pH and acid-forming spoils, sodic zones, and toxic substance occurrence in soil.

NTEC would utilize numerous stockpiles within the permit area for storing topdressing (and potentially regolith material, if needed). Stockpile surfaces (top and sides) would be managed to minimize loss from wind and water erosion. Topdressing stockpiles that are left undisturbed for greater than 6 months would also be mulched, and those undisturbed for 1 year or greater would be seeded and mulched during the appropriate seeding period.

Gradient terraces are earthen embankments or ridges that reduce erosion by slowing, collecting, and redistributing surface runoff. Gradient terraces may be built in the permit area to reduce sheet and rill erosion, prevent gullies, and provide water harvesting mechanism for the semi-arid region.

Surface Stabilization for Reclaimed Lands

As required by SMCRA, NTEC would comply with SMCRA permitting requirements for Reclaimed Lands. The control measures and techniques presented in this plan would be the best technology currently available that has been demonstrated to successfully minimize erosion from reclaimed lands and prevent excessive sediment contributions to receiving streams in the arid Southwest. To determine the most appropriate stabilization measures, NTEC would:

- Survey adjacent areas for hydrologic parameters (e.g., drainage density, channel type, etc.).
- Estimate discharge from the reclamation area.
- Compare discharge estimates with channel dimensions in the survey area to verify estimates.
- Determine the appropriate channel types for the reclamation area slopes and valley bottom using fluvial geomorphic principles.
- Design valley wall slopes with the minor channel to the determined drainage density.
- Design the appropriate major valley channel.
- Incorporate the channels into the final surface configuration for the valley wall slopes and valley bottom.

Other surface stabilization control measures that may be used include minimizing surface disturbance, using silt fences, straw bales, straw wattles, and/or sediment ponds, and seeding and mulching of reclaimed areas.

2.6.1.2.2 Four Corners Power Plant

No specific measures are proposed.

2.6.1.2.3 Transmission Lines

No specific measures are proposed.

2.6.1.3 Water Resources/Hydrology

2.6.1.3.1 Navajo Mine

Groundwater Monitoring Plan

The groundwater monitoring plan's goal is to collect data on groundwater quality and quantity to monitor any changes that may occur as a result of mining and reclamation such that if changes are detected, mining and reclamation operations can be adjusted to prevent adverse effects. The monitoring plan will collect groundwater information from specified hydrogeologic units (coal seams from Fruitland Formation, Pictured Cliffs Sandstone, and alluvium of Cottonwood and Pinabete arroyos), as well as backfill locations.

Sediment Control Procedures

NTEC will prepare and implement sediment control practices required by the SMCRA permit to help minimize sediment loss from water and wind erosion. The plan will include such methods as stabilizing stockpiles by mulching and seeding, and retaining sediment in disturbed areas using berms, sumps, or sediment ponds to capture runoff. The primary control measure to decrease sediment runoff would be the use of sedimentation ponds. Sedimentation ponds are designed to retain the surface runoff and sediment from either the 100-year/6-hour or 10-year/24-hour storm event. No discharge would occur onto undisturbed areas or beyond the permit area from precipitation events up to and including the 10-year/24-hour event. All discharges from the disturbed areas would be covered under an NPDES permit where required.

Professional Engineers would design and certify that sedimentation ponds would contain runoff from a 100-year, 6-hour or 10-year, 24-hour storm event (berms, v-ditches, or channels would be used to divert flows from the disturbed areas into the ponds).

NTEC would implement BMPs to avoid and minimize water quality effects during mining by controlling runoff and sedimentation into nearby channels, including minimization of disturbance footprints, establishment of stream buffer zones, employment of upstream diversions or highwall impoundments, use of sediment ponds, perimeter berms or containment features, and reseeding of areas prepared for reclamation as soon as practicable. NTEC would comply with SMCRA requirements and EPA NPDES permits under Clear Water Act Section 402 to control the discharge of sediment within the active mining sectors of the Pinabete and Navajo Mine permit areas.

NTEC may need to place additional ponds in series to retain the runoff and meet 40 CFR Part 434 standards until the area can be completely reclaimed. In such cases, NTEC would submit a revision to the Reclamation Plan to OSMRE for review and approval prior to initiating construction activities for additional ponds. Berms may be used to prevent sediment and flows from leaving the disturbed area and to convey flows to sedimentation ponds.

In accordance with the Stormwater Pollution Prevention Plan (SWPPP), NTEC further minimizes stormwater exposure to pollutants by implementing the following measures:

- Train employees to maintain appropriate load volumes in haulage equipment.
- Transport blasting agents in enclosed vehicles.
- Train employees to handle and manage potential pollutants and apply good housekeeping procedures.
- Minimize fugitive dust by applying dust suppression product annually and water, on an as-needed basis, to roads.
- Regular inspection and maintenance of BMPs by qualified personnel.
- Inspect mine vehicles and equipment operating on the railroad and roads for leaks or safety hazards.
- Conduct routine maintenance of vehicles and equipment to minimize the possibility of potential pollutant releases occurring from leaks or accidents in areas exposed to stormwater.

Surface Water Monitoring Plan

In accordance with the Surface Water Monitoring Plan submitted as part of the Pinabete Permit Application to OSMRE, NTEC would conduct regular monitoring of surface-water quantity and quality in Pinabete and Cottonwood arroyos for the duration of the permit period. Monitoring would be conducted at five stations (three historic and two new stations) and would be conducted quarterly. In addition, sampling is completed after storm events. Water quality monitoring results would be submitted quarterly to OSMRE.

In addition, NTEC will incorporate the San Juan River Habitat Restoration and Improvement Plan as part of its Clean Water Act Section 404 individual permitting process to mitigate and ensure no net loss of functions and services of Waters of the U.S. as a result of the proposed Pinabete Mine permitted activity (USACE 2013).

Spill Prevention, Control, and Countermeasure Plan

NTEC maintains and implements a Spill Prevention, Control, and Countermeasure (SPCC) Plan that identifies areas of risk, specifies appropriate controls for bulk storage areas, identifies control strategies for managing potential spills, and lists procedures for safely disposing of any contaminated materials.

2.6.1.3.2 Four Corners Power Plant

In accordance with their NPDES permit, FCPP operates under a SWPPP. Stormwater within the lease area either is contained via berms, discharged to Morgan Lake, or drains to one of three outfalls on site.

In addition, the following Structural Controls are used on site:

- Chemicals stored inside the Main and Chemical Warehouses
- Oil totes stored in oil storage buildings at FCPP
- Concrete apron over the dirt bank at 4/5 Intake (SW1)
- Prompt cleanup of spills and leaks using absorbents to prevent the discharge of pollutants
- Drip pans and absorbents are used under or around leaky vehicles and equipment
- Washwater drained to a proper collection system
- Rock and concrete barriers surrounding the perimeter of the plant proper next to Morgan Lake and cooling water canals leaving and entering the lake (APS 2012a)

FCPP would continue to operate in accordance with the existing NPDES permit and the SWPPP. In addition, a SPCC Plan would be implemented to prevent and contain any adverse effects of the spilled material to the surrounding environment.

2.6.1.3.3 Transmission Lines

To protect groundwater, hazardous fluid spill prevention and protection practices would be implemented during transmission line maintenance activities.

PNM and APS would implement standard construction BMPs to prevent degradation of surface waters during ground-disturbing transmission line maintenance activities such as equipment pad leveling and/or tower replacement. BMPs could include the installation of filter socks, straw waddles, or silt fences around mechanically disturbed areas to prevent sediment from leaving the site. Appropriate BMPs would be especially important when working in floodplains to protect adjacent wetlands and drainage ways.

2.6.1.4 Vegetation

2.6.1.4.1 Navajo Mine

Environmental and Biological Resource Compliance Monitoring Plan

NTEC would minimize disturbance of the native vegetation and topography to only those areas necessary to safely conduct mining activities. In addition, prior to land disturbance, vegetation and threatened and endangered species surveys were conducted and refresher studies were conducted to characterize plant communities, habitats and identify the potential for occurrence of threatened and endangered species and their habitat in the proposed mine development. Refresher surveys would be conducted as needed.

NTEC would prepare and implement a Noxious Weed Management practices to prevent the introduction and spread of noxious and invasive weeds in the permit areas. The plan would require the purchase of revegetation seeds from reputable vendors, which are not contaminated with weed seed. Similarly, NTEC would obtain native grass mulch from credible producers to minimize introduction of noxious and invasive weeds into revegetated areas. Seed vendors and mulch producers may be inspected by NTEC to audit their quality control procedures and ensure their products are free of noxious and invasive weeds. The introduction of noxious weeds will be controlled in reclaimed areas by using weed-free mulch and seed.

Other Protective Measures

NTEC would implement all BMPs and protective measures, including the following:

- All construction personnel would attend an environmental protection briefing prior to working on any construction site in the Action Area. This briefing is designed to familiarize workers with statutory and contractual environmental requirements and the recognition of and protection measures for sensitive vegetation community and wildlife habitats.
- Protective barriers would be placed around specified sensitive vegetation communities as identified by the Navajo Nation Department of Fish and Wildlife (NNDFW). Barriers would be installed prior to construction and field inspected by NNDFW or OSMRE personnel to verify proper placement.
- Aboveground structures (i.e., transmission towers) would be sited and designed to minimize disturbance to sensitive wildlife habitats and to minimize adverse effects to landscape features such as topography and vegetation.
- Imported soils, fills, or aggregates would be free of deleterious materials (i.e., trash, construction debris, noxious weeds). Sources of imported materials would be submitted for OSMRE or Navajo Nation approval prior to construction.

Fluvial Geomorphic Surface Stabilization Approach for Reclamation

NTEC has developed comprehensive revegetation plans to be implemented in both the Navajo Mine and Pinabete Permit areas based on experience re-establishing vegetation on previously disturbed areas at the Navajo Mine. Reclamation may incorporate fluvial geomorphic techniques, where possible, that are designed and constructed to restore ephemeral streams to appropriate longitudinal plans and profiles, gradients, and cross-sections, including aquatic habitats that approximate pre-mining stream channel characteristics. Implementation of the Revegetation Plans would establish a diverse, stable, and self-sustaining vegetation community composed of native species capable of meeting the post-mining land use. Both plans have been reviewed and would satisfy the following criteria:

- Adequate cover capable of stabilizing the soil surface from erosion
- Adequate forage to support the post-mining land uses (i.e., livestock grazing and wildlife habitat)
- Suitable species composition for enhancement of wildlife forage and cover

2.6.1.4.2 Four Corners Power Plant

Before vegetation is removed on the FCPP Lease Area, it is evaluated for southwestern willow flycatcher and yellow-billed cuckoo habitat. If habitat is identified, a protocol survey is conducted during seasonal presence periods. If either species is found to be present, protective measures are evaluated and adopted, in coordination with the appropriate land managing agency.

2.6.1.4.3 Transmission Lines

1. APS conducted habitat modeling to identify potentially suitable habitat for sensitive species (including federally listed species) and conducted field surveys to validate the model and identify if areas of suitable habitat were occupied in 2012 and 2013. Going forward this information would be used to plan activities within identified areas of suitable habitat to minimize potential effects on listed species.

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2. PNM has an environmental screening program that requires screening all transmission maintenance work for compliance-related environmental issues. Biological review relies on end-to-end biological surveys of the ROW corridors conducted as part of the preparation of Biological Evaluations (Marron 2012a,b; Marron 2013). Ground-disturbing work in the vicinity of suitable habitat requires protocol surveys and specific monitoring or avoidance stipulations if sensitive, threatened or endangered species are found to be present. Land managing agencies are consulted to determine the best course of action to protect the resource while conducting the necessary maintenance.
3. Vehicle access would be restricted to existing roads and within the APS and PNM ROWs, to the maximum extent possible.
4. No vegetation maintenance activities would occur within a 200-meter buffer around occupied suitable habitat for Mancos milk-vetch. All identified suitable habitat will be considered occupied and the 200-meter avoidance buffer would be applied, unless surveys for that species are conducted by a qualified botanist to determine that the species is not present.
5. No construction or maintenance activities shall be performed during periods when the soil is too wet to support construction equipment.
6. If traffic control structures (boulders, barriers, dips) must be moved, they would be returned to original position/design when work is complete
7. BMPs would be installed as necessary to reduce or prevent erosion resulting from soil disturbance.
8. Staging areas for loading and unloading of equipment would be located in previously disturbed areas, but outside of floodplains and other wet areas.
9. Biologically sensitive areas would be marked or mapped prior to construction or maintenance to avoid effects to known populations of threatened and endangered species.

Conservation Measures for Mancos milk-vetch, Fickeisen plains cactus, and Zuni fleabane for APS transmission line ROWs.

1. Within occupied or suitable habitat for the Mancos milk-vetch, Fickeisen plains cactus and Zuni fleabane, vehicles would be restricted to existing roads and two-tracks, to the maximum extent possible. To access the ROW, vehicles would park on existing roads and crews would walk into the ROW to conduct maintenance, wherever possible. If it is not possible to restrict vehicle to existing roads or two-tracks, potential effects would be minimized by reducing travel speeds and minimizing the number of trips back and forth.
2. For routine vegetation maintenance, work would be conducted by hand crews walking into the identified suitable or occupied habitat for Mancos milk-vetch, Fickeisen plains cactus, and Zuni fleabane.
3. Maintenance personnel working within suitable or occupied habitat for the Mancos milk-vetch, Fickeisen plains cactus and Zuni fleabane would report any new plants found to the Forestry natural resource specialists.
4. Except in the case of emergency maintenance, in suitable or occupied habitat for the Mancos milk-vetch, Fickeisen plains cactus and Zuni fleabane, ground disturbing activities (i.e., vehicle access into the ROW, mowing, digging, outrigger activities) would require a biological monitor to be present to observe all ground disturbing activities or surveys would be conducted prior to work to confirm whether the habitat is occupied.
5. When emergency vegetation maintenance may occur within suitable or occupied habitat for the Mancos milk-vetch, Fickeisen plains cactus, and Zuni fleabane, the Forestry natural resource

specialist would be immediately notified of the need to conduct maintenance activities. Forestry natural resource specialists would recommend best management practices to minimize impacts to suitable or occupied habitat such as minimizing vehicle travel speeds, restricting vehicle to existing roads or two-tracks when possible, and minimizing the number of trips back and forth.

Noxious Weeds Conservation Measures

For both APS and PNM transmission lines, the operator would ensure that utility mower, track, or other off-road equipment, which has high potential to carry noxious weeds (not including service vehicles, pick-up trucks, passenger cars, bucket trucks, or UTVS/ATVs) are free of soil, weeds, vegetative matter or other debris that could harbor seeds prior to entering tribal lands.

2.6.1.5 Wildlife and Habitats

2.6.1.5.1 Common to All Project Components:

- A construction work schedule would be prepared for all construction projects to minimize noise and human activity effects to wildlife in adjacent habitats.
- Protective barriers would be placed around specified sensitive wildlife habitats. Barriers would be installed prior to construction and field inspected by natural resources personnel to verify proper placement.
- Aboveground structures would be sited and designed to minimize disturbance to sensitive wildlife habitats and to minimize adverse effects to landscape features such as topography and vegetation.
- A qualified biologist would conduct preconstruction surveys, in coordination with the applicable land managing agency, to identify the number, type, and location of special-status species documented within the Project Area.
- Most initial clearing and grading for ground-disturbing construction activities would be conducted outside of the bird breeding season. If any grading, clearing, brushing, or construction were to occur during the bird breeding season (approximately February 15 through August 31), a qualified biologist would conduct a survey of the habitat to determine whether active bird nests are in the area, including raptors and ground-nesting birds. The survey would begin not more than 3 days prior the beginning of work. If an active nest was observed, a minimum 300-foot buffer (500-foot for raptors) would be established using temporary fencing. The buffer would be in effect as long as work is occurring and until the nest is no longer active.
- Speed limits would be posted in developed areas with potentially heavy traffic to minimize vehicular collisions with wildlife and decrease fugitive dust emissions.
- All construction activities would be completely confined to the areas of potential ground disturbance for each Project component. Clearing of vegetation and ground disturbance would be minimized to the greatest extent possible.
- Any new stationary noise sources would be located as far as possible from sensitive wildlife habitat areas; movement of existing mine infrastructure is not part of the Proposed Action.
- Where threatened or endangered wildlife could be present, excavation sites would be monitored or covered to avoid trapping wildlife, and routes of escape for wildlife would be maintained. The construction site would be inspected daily for appropriate covering and flagging of excavation sites. Each morning the construction site would be inspected for wildlife trapped in excavation pits.
- Proposed electrical transmission and distribution lines at the Navajo Mine would be designed and constructed utilizing the most current "raptor-safe" design (APLIC 2006). Similarly proposed

maintenance of electrical transmission and distribution lines would use the most current "raptor-safe" design.

- Following completion of any construction activities, all tools, equipment, barricades, signs, surplus materials, debris, and rubbish would be removed from the Project work limits upon completion.
- The effect of dust pollution on wildlife would be expected to be localized near construction areas and would be minimized by dust control measures such as dust suppression (watered with water trucks), stockpile stabilization, and appropriate use of haul roads.

2.6.1.5.2 Navajo Mine

Wildlife Protection

No permanent water bodies capable of supporting year-round fish populations are present within the SMCRA permit area. Measures protective of hydrologic features are summarized in Section 2.5.1.3. In addition to the measures listed above, NTEC would implement monitoring and mitigation measures to reduce short-term and long-term effects to wildlife. Proposed measures include monitoring the existing populations, conducting pre-disturbance surveys, and mitigating lost habitat features, such as nests, dens, or burrows.

Wildlife Monitoring and Mitigation Program

BNCC has implemented and NTEC would maintain a wildlife monitoring program for the Navajo Mine Lease Area that extends from Area 4 North northward through Area 1. The monitoring and mitigation plan for the Navajo Mine Permit Area, combined with the current Navajo Mine (OSMRE Permit No. NM-0003F) wildlife monitoring plan has the following objectives:

- Assure that mitigation measures are limiting the effect of mining as intended.
- Identify the presence of additional important wildlife habitats that may occur (e.g., new raptor nests).
- Identify additional unanticipated effects that require development of specific mitigation measures.
- Describe and characterize the wildlife use of reclaimed areas.
- Generally track important wildlife activities in the mine lease area.

Procedures employed to minimize or prevent effects to wildlife during the operation of the mine would include (1) limiting the amount of vegetation and topography disturbed to only that necessary to conduct mining; (2) designing facilities, such as transmission lines, to prevent mortality of raptors; and (3) monitoring important wildlife habitat, such as raptor nests, so appropriate plans to avoid significant undesirable effects can be developed and implemented.

Minimizing the area disturbed to only that necessary to safely conduct mining would avoid unnecessary disturbance of wildlife habitat. Location of important wildlife habitats (such as rim rocks, raptor nests, and water sources) would be considered when planning the location of haul roads and ancillary facilities so that they can be avoided as much as practicable. Wildlife would be monitored during daily mining activities. The presence of any threatened or endangered species will be noted and OSMRE and NNDFW would be notified immediately, if these species are present.

To protect raptors from direct mortality due to electrocution, the design and construction of electric power lines and other transmission facilities on the permit area will meet the NNDFW guidelines and those set forth in *Suggested Practices for Raptor Protection on Power lines–the State of the Art in 2006* (APLIC 2006).

NTEC also implements a Raptor Monitoring Program on 3-year recurrent cycles as follows:

- **Year 1:** Aerial survey of all raptor nesting habitat within the permit area and a 1-mile buffer zone (with exception of agricultural fields disturbed and operated by Navajo Agricultural Products Industry [NAPI])
- **Years 2 and 3:** Ground survey of all raptor habitat within a 1-mile buffer zone (with exception of agricultural fields disturbed and operated by NAPI) of the most active mining areas (active pits, coal stockpiles, shop and office areas, major topdressing stockpiles, and future mining pits) where the majority of the noise and disturbance by mining or mine personnel activity will take place

Raptor surveys would be conducted during the breeding season (April through June) to document the status of known and unknown nests (e.g., active, inactive). Initial surveys will be conducted between April 1 and 15 and follow-up surveys of those areas determined as active territories would be conducted between May 15 and June 15 (or closest date a suitable aircraft is available).

Buffer zones would be established around active raptor nests located on and adjacent to the permit area. The buffer zones would be established through consultation with OSMRE on a site- and species-specific basis as necessary. Raptor nests would be monitored to identify potential problem areas relative to the mining operations on the permit area. If raptor nesting success is affected by mining activity, NTEC would consult with the NNDFW, OSMRE, and USFWS to develop plans to limit effects. Such plans would be developed on a site by site basis and could include rescheduling of mining activities and moving or taking of nests as necessary. Any work involving the handling of raptors or their nests would require special permits and would be closely coordinated with the NNDFW and USFWS to ensure the safety of the birds and promote the use of the breeding territory in the future.

Unless authorized by NNDFW, prairie dog colonies with active nesting burrowing owls would not be disturbed during the nesting season (March through August) to avoid effects to active nests. Prior to conducting surface disturbance activities during the nesting season areas would be examined to determine if burrowing owls are nesting. If burrowing owls are nesting, activities that would disturb the nest would be managed to mitigate effects or other appropriate measures will be conducted as necessary after consultation with the NNDFW and USFWS. Historic and active prairie dog towns would be monitored for possible burrowing owl occupation during the 2- and 3-year raptor surveys.

Reoccupation of the reclaimed area by prairie dogs and other burrowing mammals would be monitored to determine if burrows will be available for use by burrowing owls. If no burrows are present on reclaimed areas, NTEC would consult with the NNDFW OSMRE to determine if artificial burrows are necessary on the reclaimed area to promote use by burrowing owls. Burrowing owls have readily accepted artificial burrows (BNCC 2009; BNCC 2012a), but the acceptance of artificial burrows on reclaimed areas has not been proven (BNCC 2009).

In accordance with reclamation plan, rock habitat structures will be constructed in reclaimed areas to provide perches for birds and cover for small- and medium-sized mammals and reptiles. Disturbed areas will be revegetated to create diversity in vertical and horizontal plant community structures. These areas will be revegetated with seed mixes that contain multiple species that are native to the area, palatable to livestock and various wildlife species, and provide wildlife cover. Specific surveys will be conducted to monitor wildlife use of reclaimed areas annually during the summer and winter.

2.6.1.5.3 Four Corners Power Plant

Before vegetation is removed on the FCPP lease, it would be evaluated for southwestern willow flycatcher habitat. If habitat is identified, a protocol survey would be conducted during seasonal presence periods. If southwestern willow flycatchers are found present, protective measures would be evaluated and adopted.

2.6.1.5.4 Transmission Lines

APS and PNM have internal wildlife special-status species and avian protection programs that identify BMPs and avoidance measures. These BMPs and avoidance measures for transmission line maintenance activities are intended to reduce effects to special-status species that may utilize habitat within the ROW or protected avian species that nest or perch on the transmission structures.

These avian-specific conservation and protection measures afford protection to all avian species, including southwestern willow flycatcher and yellow-billed cuckoo. These measures include clearing vegetation for ground-disturbing activities outside of critical breeding and nesting periods to reduce or eliminate direct effects to avian species during these critical life stages and comply with the provisions of the Migratory Bird Treaty Act and Bald and Golden Eagle Protection Act. These provisions would include proper timing of vegetation management activities associated with the ROWs to reduce or eliminate effects to breeding and nesting avian species.

Both the APS and PNM high-voltage transmission lines are constructed in compliance with National Electric Safety Code and internal engineering standards. The transmission lines substantially exceed the USFWS-recommended APLIC minimum 60-inch-horizontal and 40-inch-vertical recommended conductor spacing to reduce risks of raptor electrocutions. As a general rule, APLIC design recommendations were developed to reduce avian electrocution risk along distribution lines, which are generally much smaller than the APS or PNM transmission lines. By design the conductor separation for the APS and PNM line voltages (500- and 345-kV) is in excess of 12 feet, well over the APLIC-recommended conductor spacing. These standards would continue to be met in the future.

During vegetation maintenance activities:

- Workers would watch for nesting birds. If an active nest is found, the vegetation containing the active nest would be avoided until after the nesting season. If active nests must be relocated for safety or reliability reasons, protocols found within the APS or PNM Avian Protection Plan would be followed.
- For herbicide treatments, between April 15 and August 15, the contractor would watch for nesting birds (ground and canopy nesting species) when driving the spray vehicle within the ROW. If any are seen, the operation would be stopped and the area completed utilizing handheld or backpack sprayers, while keeping the quad/UTV mounted sprayers on the existing road. For nests in living plants, spraying would cease and be postponed until after August 15.
- While working in riparian areas, workers would reduce the number of trips in and out, use hand crews if possible, minimize time spent working within the riparian area, and/or stage vehicles and materials outside riparian areas if possible.

A small amount of suitable habitat has been identified for Mexican spotted owl adjacent to, but not within, the APS transmission line ROWs. If suitable nesting habitat for Mexican spotted owls is identified within 0.25 mile of the transmission lines, APS would implement breeding season timing restrictions from March 1 to August 31 for all routine maintenance activities.

<u>Wildlife Protection Program</u>

All transmission structures have been designed with adequate line clearances to prevent electrocutions and meet APLIC design guidelines. In addition to the measures listed above, to identify and manage risk to avian species by electrocution, APS implements a Wildlife Protection Program designed to minimize the danger of energized lines for birds of prey and a variety of mammals. Similarly, PNM documents collisions and electrocutions to identify wildlife hazards across their service area and implements proactive bird guarding to reduce them. The BMPs and avoidance measures for transmission line maintenance activities are intended to reduce effects to special-status species that may utilize habitat within the ROW or protected avian species that nest on the transmission structures.

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2.6.1.6 Special-Status Species

Wildlife would be monitored during daily mining activities by mining operations staff. The presence of any threatened or endangered species would be noted and OSMRE and NNDFW would be notified immediately if present.

2.6.1.6.1 Hazardous Waste Management

NTEC implements a Waste Management Plan and chemical procurements system and complies with all applicable tribal, state, and federal waste handling, management, and disposal regulations for proper handling and disposal of all wastes, including universal wastes, special wastes, and recycled materials, generated at the Navajo Mine.

2.6.1.6.2 Four Corners Power Plant

APS implements a Pollution Prevention and Waste Management Plan and Chemical Procurement Procedure to minimize waste generation, including universal, special, recycled, solid, and hazardous waste. The plan and procedure comply with all waste management regulations.

2.6.1.6.3 Transmission Lines

No specific measures are proposed.

2.6.2 Development of Colorado Pikeminnow Population Viability Analysis Model

During this Section 7 consultation, the Applicants will coordinate and fund development of a Colorado pikeminnow population viability analysis (PVA) model for the San Juan River Basin to assess management options that best support conservation and recovery of the species based on specific scenarios representing existing and future environmental conditions. The PVA model will be made available to the USFWS for use in the San Juan River Basin Recovery Implementation Program (SJRRIP) for the SJRRIP's future use following the Section 7 consultation process for the Project.

2.6.3 Support of the San Juan River Recovery Implementation Program

The Applicants would continue to support and participate in the SJRRIP. The objectives of the SJRRIP goals are to conserve populations of Colorado pikeminnow and razorback sucker in the San Juan River Basin consistent with the species recovery goals established under the ESA and to protect water development in the Basin in compliance with federal and state laws, interstate compacts, Supreme Court decrees and federal trust responsibilities to the Southern Utes, Ute Mountain Utes, Jicarillas, and the Navajos. The activities associated with the program are described in Section 5.1.7.

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3 Analytical Framework for the Effects Analysis

3.1 Effects on Species

The effects analysis relies on four components to assess the potential effects on the species considered in this BA. The four components are (1) the Species Life History and Critical Habitat, which evaluates the species rangewide condition and the factors responsible for that condition, as well as the species survival and recovery needs; (2) the Environmental Baseline, which evaluates the condition of the species in the Action Area, the factors responsible for that condition, and the role of the Action Area in the species survival and recovery; (3) the Effects of the Proposed Action, which determines the direct and indirect effects of the proposed federal action and the effects of any interrelated or interdependent activities on the species, as measured against the Environmental Baseline; and (4) Cumulative Effects, which evaluates the effects of future, non-federal activities in the Action Area on the species.

The direct and indirect effects of the proposed federal action are evaluated first, in and of themselves, and then in the context of the aggregate effects of all factors that have contributed to the species current status, and in the context of reasonably foreseeable non-federal activities in the Action Area. This analysis is used to determine if implementation of the Proposed Action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the species in the wild, when measured against the Environmental Baseline. The analysis places an emphasis on using the range-wide survival and recovery needs of the species and the role of the Action Area in providing for those needs.

3.2 Effects on Critical Habitat

The analysis of effects on critical habitat relies on four components: (1) the Species Life History and Critical Habitat, which evaluates the range-wide condition of designated critical habitat for Colorado pikeminnow and razorback sucker in terms of primary constituent elements (PCEs), the factors responsible for that condition, the intended recovery function of the critical habitat overall, and the intended recovery function of discrete critical habitat units; (2) the Environmental Baseline, which evaluates the condition of the critical habitat in the Action Area, the factors responsible for that condition, and the recovery role of the critical habitat in the Action Area; (3) the Effects of the Action, which determines the direct and indirect effects of the proposed federal action and the effects of any interrelated or interdependent activities on the PCEs and how it will influence the recovery role of affected critical habitat units; and (4) Cumulative Effects, which evaluates the effects of future, non-federal activities in the Action Area on the PCEs and how that will influence the recovery role of affected critical habitat units.

The Proposed Action's direct and indirect effects on critical habitat are evaluated to determine if the critical habitat would remain functional (or retain ability for the PCEs to be functionally established in areas of currently unsuitable but capable habitat) and continue to serve the intended recovery role for the species. The direct and indirect effects are evaluated independently and collectively with the other factors that have contributed to the current status of the critical habitat range-wide or other factors that may be attributable to future non-federal actions.

The adverse modification determination is based on the significance of effects from the Proposed Action on the intended range-wide recovery function of critical habitat for the different species. The determination includes cumulative effects.

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4 Ecological Risk Assessments

4.1 Overview

Federally listed plants and animals in both terrestrial and aquatic environments are currently exposed to chemicals present in soil, water, and sediment within the Action Area. The sources of these chemicals include past FCPP operations; other regional emission sources, including, but not limited to, the Navajo Generating Station and San Juan Generating Station; municipal, industrial, and agricultural runoff; global emission sources; and for most chemicals of interest, natural background. Under the Proposed Action, FCPP will continue to operate until 2041 and continue to emit air pollutants.

The evaluation of the potential effects of future emissions from the FCPP was based on two ERAs conducted to evaluate potential ecological effects associated with future emissions from the production of electricity at the FCPP (25 years of Units 4-5 operation with SCR) (AECOM 2013b,c). Both ERAs evaluated generic ecological receptors as well as federally listed, proposed, and candidate species. One ERA was conducted to identify risks to both terrestrial and aquatic environments within the area identified by air dispersion modeling (CALPUFF) as having a 1 percent future increase in soil metals concentrations above current condition (baseline) metals concentrations (AECOM 2013b). This area is referred to as the Deposition Area and is shown on Figure 2-1. The accumulation of less than 1 percent of metals above current conditions over the 25-year life of the Proposed Action was considered discountable.[2] This ERA is hereafter referred to as the Deposition Area ERA.

The second ERA was conducted to evaluate ecological risks associated with current conditions and future FCPP emissions, as well as future regional and global emissions for the aquatic environment of the San Juan River, within the deposition area and downstream of the deposition area into the San Juan River arm of Lake Powell ("San Juan River ERA") (AECOM 2013c). This ERA is hereafter referred to as the San Juan River ERA. This ERA was specifically formulated to evaluate the effects of future accumulation of mercury, arsenic, and selenium, which are known to be transported globally through the atmosphere (EPRI 2014).

Both the Deposition Area and San Juan River ERAs were conducted following EPA (1997a, 1998) guidance whereby the ERA framework comprises four key elements: (1) Problem Formulation, (2) Exposure Assessment, (3) Toxicity Assessment, and (4) Risk Characterization. Problem formulation comprises the initial planning steps, characterization of environmental setting, identification of chemicals of potential ecological concern (COPECs), representative ecological receptors, special-status species, assessment and measurement endpoints, and the completion of the site conceptual model. The Exposure Assessment and Toxicity Assessment elements are the quantitative components of the ERA's analysis phase, where the Exposure Assessment comprises the estimation of exposure point concentrations (EPCs) and the receptor-specific exposures. The Toxicity Assessment comprises the review of chemical-specific toxicity information available in the peer-reviewed literature and government agency documents, and the selection of applicable toxicity metrics for assessing the risk or hazard to receptors from chemical exposures. The Risk Characterization phase of the ERA comprises the integration of exposure and toxicity data to estimate and characterize ecological risk.

For both ERAs, baseline conditions were determined through review of existing datasets (U.S. Geological Survey [USGS] gages; Simpson and Lusk 1999; APS 2011; USFWS 2005; Esplain 1995; USGS 2012 PLUTO database; URS 2008) and collection of Project-specific soil and sediment samples within the Deposition Area (AECOM 2013b). Project-specific samples were collected from different soil types within

[2] Using a percentage of background as a threshold for deposited metals is consistent with the acidic deposition screening approach established by the Federal Land Manager's Air Quality Related Values Work Group (U.S. Forest Service, NPS, and USFWS 2010, as cited in AECOM 2013a).

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the Deposition Area. Eight sediment samples were collected from Morgan Lake to supplement existing information.

These environmental datasets (soil, water, sediment, and fish tissue) were assumed to integrate the contributions of local, regional, and global sources, as well as natural background COPEC concentrations. In the ERAs these data are referred to as Current Conditions data. Both the Deposition Area and San Juan River ERAs reported risk estimates for Current Conditions, which are discussed below as Environmental Baseline.

4.2 Summary of the Models

Following is a detailed summary of the risk assessment and fate and transport modeling approaches used in the two ERAs.

4.2.1 Deposition Area ERA

In order to delineate the area to be evaluated in the Deposition Area ERA, preliminary air dispersion and deposition modeling was conducted to assess the potential extent of future deposition associated with the Proposed Action. Modeling was used to estimate potential changes to soil concentrations associated with 25 years of additional deposition from future FCPP operations under the Proposed Action. Based on a study by EPRI (2011) as well as other studies, arsenic, cadmium, chromium, mercury, antimony, lead, copper and selenium are understood to be the primary risk drivers for adverse ecological effects associated with coal-fired power plants. Therefore, dispersion and deposition modeling of these eight metals was completed to delineate the terrestrial area to be evaluated in the Deposition Area ERA. The CALPUFF[3] model was applied within a 300-km radius of the FCPP to simulate dispersion and deposition of the metals to estimate the contribution of future continuous full load operations of the FCPP stacks[4] for 25 years to surface soil concentrations in the region.

The future surface soil concentrations of each metal calculated to accumulate over 25 years were computed (based on CALPUFF modeling and IRAP-h software[5]) and compared to the corresponding 95 percent upper confidence limit on the mean (95% UCL)[6] of the estimated existing soil concentrations derived from the PLUTO database for San Juan County, NM (USGS 2012).[7] The ERA Deposition Area, shown in Figure 2-1, was determined by delineating the area where the predicted incremental increase in soil concentration of any of the metals due to 25 years of future full load plant operations is projected to be more than 1% of current concentrations (based on the PLUTO data). As noted previously, beyond this area, the very small increase in soil concentration associated with the Proposed Action was sufficiently low to be considered discountable.

Because the deposition area extended less than 50 km from the FCPP, further detailed air dispersion and deposition modeling needed to support the Deposition Area ERA was performed using AERMOD (version 12345)[8] to quantify future emissions from the FCPP stacks that would be added to the existing concentrations in the soils within the Deposition Area over 25 years. This was done in order to assess the

[3] CALPUFF is the EPA-approved model to simulate dispersion and deposition over a large area for long-range transport and complex terrain on scales of tens to hundreds of kilometers.
[4] For the purposes of evaluating future operations, this refers to units 4 and 5 with SCR installed.
[5] IRAP-h (Lakes Environmental, Waterloo, Ontario, Canada) is a commercial software package that implements the EPA (2005) Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities. The fate and transport modeling components of this software were used in the Deposition Area ERA.
[6] The 95 % UCL is an estimate of the average concentration with 95 percent confidence that the true mean concentration is less than this value. This value was used to help determine the extent of the deposition area because it is expected to represent a reasonable estimate of soil concentrations across the potentially impacted area.
[7] USGS data from the county were used at this early stage of the project due to a lack of site-specific soil data. Once the deposition area was established, site-specific soil data were collected to support the ERA.
[8] AERMOD is the EPA-approved steady-state plume model that incorporates air dispersion for simple and complex terrains. It is designed for short-range modeling up to 50 km.

terrestrial exposure to COPECs from FCPP stack emissions under the Proposed Action. This is also referred to in the Deposition Area ERA as "Deposition-Related Contributions." The AERMOD modeling was extended to a 50-km radius of the FCPP in order to allow the ERA fate and transport model (IRAP-h software) to predict the contributions of COPECs to the water bodies within the Deposition Area from upstream watersheds.

The Deposition Area ERA established Current Conditions (also referred to as "baseline" in the BA) within the Deposition Area for surface soils, surface water, sediment, and fish tissue based on available data sets and site-specific sampling. Soil sampling was undertaken at 35 locations and eight sediment samples were collected from Morgan Lake.

The Deposition Area ERA considered both generic ecological receptors and special status species receptors[9]. The Deposition Area ERA identified potentially complete exposure pathways for the identified receptors, selected assessment endpoints and measures of effect to evaluate impacts on the receptors, and developed an ecological conceptual site model to describe how ecological receptors may come into contact with deposition-related constituents, including direct contact with surface soil, surface water or sediment, root uptake by terrestrial plants, bioaccumulation of surface water and sediment COPECs in higher trophic level fish, and ingestion of impacted food items, soil, sediment, and drinking water by wildlife.

AERMOD and IRAP-h were used to estimate soil, sediment, and water concentrations associated with future contributions from the Proposed Action. To assess potential risks to identified receptors, hazard quotients (HQs)[10] were calculated for each COPEC/receptor combination. The HQ is not a predictor of risk but rather is an index used to indicate whether there is potential risk. When the screening level HQ based on the maximum detected concentration was less than 1 (i.e., the maximum concentration was less than the ecological screening value), exposure to the COPEC was assumed to fall below the range associated with adverse effects. For screening level HQs greater than 1, the COPEC/receptor combination was carried through to the refined evaluation. The refined evaluation considered alternative exposure point concentrations, typically represented by the 95% UCL (unless sufficient samples were not available and the maximum value was used). In the refined evaluations, HQs were also calculated based on average exposure point concentrations, represented by the arithmetic average.

A food web model was used to evaluate potential ecological risk via bioaccumulation pathways to representative mammalian and avian receptors that may feed within the Deposition Area and may potentially be exposed to bioaccumulative compounds found in these environments. To address potential food web impacts to fish due to bioaccumulative compounds, fish tissue concentrations were estimated and evaluated against tissue-based screening levels referred to as critical body residues (CBRs).

For the purpose of evaluating potential risks to wildlife, toxicity reference values (TRVs) were established for each COPEC for both avian and mammalian receptors according to EPA guidance (EPA 2002, 2007a, 2009a,b), ORNL's publication Toxicological Benchmarks for Wildlife: 1996 Revision (Sample et al. 1996), and the Los Alamos National Laboratory (LANL) EcoRisk Database (LANL 2012). The TRVs were based on endpoints commonly evaluated in ERAs, including mortality, growth, and reproduction to be protective of a wide range of adverse effects, including effects that may result from relatively short-term exposure during sensitive life stages (e.g., breeding).

The Deposition Area ERA then estimated risks based on the integration of COPEC exposure and stressor response and characterized the potential for risks within the Deposition Area due to Current Conditions and FCPP future operations (i.e., emissions and deposition associated with the Proposed Action). After addressing uncertainties in the ERA process, the ERA concluded with a summary of risk conclusions.

[9] A habitat model and biological survey were developed for the terrestrial environment within the deposition area to assess where habitat for various species was likely to occur (AECOM 2013c).

[10] An HQ is calculated as an exposure point concentration (or dose) divided by the appropriate ecological screening value (or toxicity reference value).

4.2.2 EPRI Modeling

To assess the contributions of arsenic and selenium from regional power plants (FCPP, San Juan Generating Station, Navajo Generating Station) and the local, regional, and global contributions of mercury to water, watershed compartments, and biota in the San Juan River basin extending down to the San Juan arm of Lake Powell, EPRI developed a regional air quality model and coupled the output with a watershed biogeochemical cycling and aquatic biota bioaccumulation model. Figure 2-1 displays the San Juan River watershed that was used for this model. The methods used are summarized below from EPRI (2014).

The EPRI CMAQ-APT model was used for modeling atmospheric transport and deposition of arsenic, mercury, and selenium in the San Juan Basin region. This regional-scale model has as its core the U.S. EPA CMAQ model and applies an advanced plume treatment (APT) module for more precision closest to the sources. The Weather Research and Forecasting meteorological model (WRF) was used to simulate the entire depth and breadth of the regional atmosphere. For mercury, the global GEOS-Chem model, based on the NASA GEOS atmospheric global transport model combined with a Harvard University atmospheric chemistry simulation model, was used to simulate the movement of mercury from distant sources into U.S. airspace.

The CMAQ-APT model was used to produce wet and dry atmospheric deposition inputs to the Watershed Analysis Risk Management Framework (WARMF) model. WARMF is a three-dimensional dynamic model that uses a comprehensive mechanistic based modeling framework, which was applied to the San Juan River watershed and used to simulate the watershed transport, transformation and bioaccumulation processes to calculate concentrations of arsenic, selenium, and mercury in the water and mercury in the fish. WARMF calculates concentrations and movement of particular substances through the terrestrial and aquatic components of the San Juan Basin. WARMF quantifies the relationship between atmospheric deposition plus direct input from watershed sources of chemicals, and resulting concentrations in surface water (concentrations in invertebrate and fish tissue were also estimated for mercury).

Prior to the use of WARMF in the San Juan River Basin, the mercury processes included in WARMF had been the subject of a peer review by experts in a number of specific areas of study of mercury. The review panel's recommendations were incorporated into the WARMF algorithms, and a follow-up review confirmed that the model's simulation algorithms represent the state of the science. The WARMF model was also set up to simulate both the transport and transformations of arsenic and selenium.

CMAQ-APT was used to generate atmospheric deposition for several potential scenarios of emissions from local coal fired power plants as well as atmospheric sources of mercury external to the San Juan Basin. The four air dispersion and deposition modeling simulations performed were:

1. base case "current" emissions, with all five FCPP units operating, current San Juan Generating Station (SJGS) and Navajo Generating Station (NGS) emissions, and current world mercury emissions;
2. post-EPA Mercury and Air Toxics Standard (MATS) rule emissions for FCPP (2014 for post-MATS, also assuming Units 1-3 were retired[11])), SJGS (2016 for post-MATS) and NGS (2016 for post-MATS);
3. a lower estimate of future Chinese emissions; and
4. a higher estimate of future Chinese emissions.

In each of the China cases, FCPP, NGS and SJGS were modeled post-MATS, and current world emissions were also included in the modeling.

[11] There was no information on the incremental benefit of new SCR for Units 4-5, thus no additional reductions were applied for that element.

To evaluate the effect of these different emission scenarios on selenium and arsenic concentrations in the water column and mercury in the water column and aquatic biota, the watershed model was run using output from each of the CMAQ-APT scenarios. Six scenarios identified below were then evaluated using WARMF. The WARMF modeling was run from 1990 thru 2074 to provide a continuous trajectory for the fish tissue concentrations.

- **Scenario 1 (Base Case).** FCPP closes in 2041, NGS closes 2044, no change in China emissions.[12]
- **Scenario 3.** FCPP closes in 2016, NGS closes 2044, low increase in China emissions.[13]
- **Scenario 4.** FCPP closes in 2016, NGS closes 2044, high increase in China emissions.
- **Scenario 5 (Four Corners Removed).** FCPP never existed, NGS closes 2044, no change in China emissions.
- **Scenario 7.** FCPP closes 2041, NGS closes 2044, low increase in China emissions.
- **Scenario 8.** FCPP closes 2041, NGS closes 2044, high increase in China emissions.[14]

In all scenarios, SJGS was kept in operation until 2074, and conservatively assumed no reduction in emissions beyond post-MATS operation for all units (e.g., no potential emissions reductions from possible future BART requirements were modeled). Scenario 8 represents the highest emissions-related contributions to the watershed, with Scenarios 1, 3, 4, 5, and 7 representing slightly lower contributions. By comparing the watershed model results among the scenarios, it was possible to isolate the effects of various potential future emissions conditions. For example, subtracting the results for Scenario 4 from Scenario 8 (or Scenario 3 from Scenario 7) allows us to isolate FCPP-only contributions.

4.2.3 San Juan River ERA

The EPRI modeling was used in the San Juan River ERA to address potential risks due to arsenic, mercury and selenium deposition from multiple sources to aquatic and riparian (birds and mammals) receptors in the San Juan River basin. The ERA analysis encompassed the area between the eastern boundary of the area evaluated in the Deposition Area ERA downstream to the confluence of the San Juan River with the Colorado River. This included the San Juan River arm of Lake Powell. For the purposes of the San Juan River ERA, this portion of the river was divided into three ecological exposure areas based on the USFWS reaches evaluated by Simpson and Lusk (1999), while the San Juan River arm of Lake Powell was evaluated as a fourth exposure area.

The San Juan River ERA quantitatively evaluates potential ecological risks associated with two of the exposure scenarios: (1) Current Conditions + FCPP-only Contributions and (2) Scenario 8 Contributions, summarized above. As already noted and as used in the San Juan River ERA, “Current Conditions” refers to the data set representing existing media concentrations within the San Juan River Study Area[15] while “Deposition-Related Contributions” are those modeled by EPRI to quantify the deposition of arsenic, mercury, and selenium under various scenarios. Current Conditions data were not added into the Scenario 8 evaluation because the WARMF model calibration accounts for current concentrations within the San Juan River. In the San Juan River ERA, contributions to ecological risks due to Scenarios 1, 3, 4, 5, and 7 were considered qualitatively relative to the risks identified for the Scenario 8 Contributions

[12] Mercury emissions held constant at 2007 levels.
[13] Mercury transport and deposition to the watershed decreases slightly because of a shift in the speciation, or chemical form, of the emitted mercury. See EPRI (2013) for details.
[14] Unlisted scenario numbers have been reserved for future calculations that do not include FCPP emissions scenarios.
[15] Current Conditions concentrations were established based on a review of available data for surface water, sediment, and tissue. Historic analytical data were obtained from various governmental and non-governmental agencies and reports.

exposure scenario. These alternate values are not considered in this BA, as they were very similar in magnitude of COPEC concentrations.

Similar to the Deposition Area ERA, the San Juan River ERA identified appropriate ecological receptors and potentially complete exposure pathways.[16] The San Juan River ERA then selected assessment endpoints and measures of effect to develop a conceptual ecological site model. Also similar to the Deposition Area ERA, HQs were calculated for each COPEC/receptor combination, to assess potential risks to identified receptors. The San Juan River ERA then estimated and characterized the potential for risks within the San Juan River Study Area due to current conditions, FCPP future operations (i.e., emissions and deposition associated with the Proposed Action), and regional and global contributions to the watershed modeled by EPRI. After addressing uncertainties in the ERA process, the San Juan River ERA concluded with a summary of risk conclusions.

4.2.4 <u>Summary of Differences Between the Two ERAs</u>

The two ERAs were conducted following the same methodology with the following key exceptions:

1. The Deposition Area ERA evaluated potential ecological risks to both terrestrial and aquatic (and riparian) receptors within the Deposition Area. The San Juan River ERA evaluated potential ecological risks only to aquatic and riparian receptors in the San Juan River both within the Deposition Area and in the San Juan River from the Deposition Area downstream to, and including, the San Juan River arm of Lake Powell.
2. The Deposition Area ERA identified 20 metals, 17 polycyclic aromatic hydrocarbon (PAH) compounds, 17 polychlorinated dibenzo(p)dioxin and dibenzofuran (dioxin/furan) congeners, acrolein, benzene, sulfuric acid, hydrogen chloride, and hydrogen fluoride as COPECs. The San Juan River ERA evaluated ecological risks associated with exposure to three metals known to have regional and/or global distribution patterns: arsenic, mercury, and selenium.
3. Air dispersion and deposition modeling was conducted by AECOM for the Deposition Area ERA using the AERMOD short-range dispersion model, whereas air dispersion and deposition modeling for the San Juan River ERA was conducted by EPRI using a global-scale model (GEOS-Chem) and a regional-scale model (CEMQ-APT). The air dispersion and deposition modeling conducted by AECOM is described in the Deposition Area ERA (AECOM 2013b). The air modeling and deposition conducted by EPRI is described in EPRI (2014).
4. Fate and transport modeling for the Deposition Area ERA was conducted by AECOM using IRAP-h software, developed by Lakes Environmental, which implements the EPA (2005a) Human Health Risk Assessment Protocol (HHRAP) for Hazardous Waste Combustion Facilities. Fate and transport modeling for the San Juan River ERA was conducted by EPRI using the Watershed Analysis Risk Management Framework (WARMF) model to estimate surface-water concentrations for arsenic, mercury, and selenium, and fish tissue concentrations for mercury (AECOM 2013c; EPRI 2014).
5. In the Deposition Area ERA, fish exposure to mercury was estimated using literature-based bioaccumulation factors. In the San Juan River ERA, mercury exposure to fish was estimated using a food-web model (included in the WARMF model).
6. The Deposition Area ERA evaluated and compared ecological risks associated with current conditions and future FCPP emissions, but not future regional and global emissions. The San Juan River ERA evaluated and compared ecological risks associated with current conditions and future FCPP emissions, and future regional/global emissions.

[16] USEPA (1997, 1998a) defines a complete exposure pathway as "one in which the chemical can be traced or expected to travel from the source to a receptor that can be affected by the chemicals."

7. A habitat model and biological survey were developed for the terrestrial environment within the Deposition Area to assess where habitat for various species was likely to occur (AECOM 2013d).

4.3 Interpretation of ERA Findings Relative to Federally Listed Species

It is important to recognize that these ERAs do not directly address potential effects to species communities or populations, but rather address potential effects to individuals. For generic ecological receptors, population-level effects may be of greater relevance than effects to individuals. It is generally assumed that as the number of affected individuals increases, the likelihood of population-level effects also increases. However, effects on individual organisms may occur with little or no population or community-level effects and, therefore, the analysis presented here is considered conservative in the context of population-level risk. Nevertheless, for special-status species and, in particular, federally listed species, potential effects to individuals may be relevant, especially for immobile early life-stage individuals.

ERAs, as conducted following EPA (1998) ERA framework, provide quantitative estimates intended to identify when exposure to COPECs exceeds thresholds below which adverse effects to individual receptors are unlikely to occur. The risk estimate, or hazard quotient (HQ), is determined by computing either (1) the ratio of a COPEC concentration in the environment (soil, sediment, water, fish tissue EPC) to a media-based toxicity benchmark or (2) the ratio of the estimated daily dose to a toxicity reference value (TRV).

The unitless metric that defines this threshold is referred to as the HQ, and the threshold value is 1. An HQ exceeding 1 does not mean that an adverse effect *will* occur, but is used to flag those situations where an effect is more likely to occur. COPECs with an HQ less than 1 are considered unlikely to present any risk. It is important to note that the HQ's calculated value does not directly correspond with the magnitude of adverse effect (e.g., an HQ of 10 does not indicate that the effect would be 5 times greater than an HQ of 2), but suggests that an adverse effect is more likely to occur, although the probability would not necessarily be 5 times higher. It is also important to note that ERAs conducted in this manner do not directly provide information on effects to populations.

It is crucial that the interpretation of the ERA results (e.g., HQs) is aligned with the toxicological basis for the toxicity benchmarks used to calculate HQs. For birds and mammals, TRVs were taken from EPA sources and were based on endpoints commonly evaluated in ERAs, including mortality, growth, and reproduction (AECOM 2013b,c). The EPA-derived TRVs are implicitly protective of a wide range of adverse effects, including reproductive and developmental effects that may result from relatively short-term exposure during sensitive life stages (e.g., breeding). The same is true for the media-based toxicity benchmarks for soil, water, sediment, and fish tissue used in the ERAs.

For the purpose of this BA, the assessment of federally listed species considers the following:

1. The BA focuses on HQs based on no-observable-adverse-effect-level (NOAEL) TRVs. While possibly viewed as overly conservative, HQs that are based on lowest-observable-adverse-effect-level (LOAEL) TRVs imply that an HQ of 1 corresponds to an effect level. Where an HQ of 1 is the default point of departure or threshold for expressing the likelihood of adverse effects, setting this threshold to correspond to an effect level would not be appropriate for the assessment of federally listed species. Thus, it was considered prudent and appropriate to base this assessment on HQs that are based on NOAEL TRVs, not LOAEL TRVs.
2. The ERAs provided HQ estimates using up to four different scenarios for calculating EPCs:
    a. An initial screening evaluation using maximum media concentrations
    b. A refined evaluation using the lower of the maximum media concentrations or the 95 percent upper confidence on the mean (95% UCL) media concentrations
    c. An alternative refined evaluation used the arithmetic average media concentrations

   d. For federally listed plants, maximum soil concentrations from areas found to have suitable species-specific habitat were used to evaluate risks

3. For the assessment of early life-stage receptors that are not mobile, HQs based on maximum media concentrations are applicable for federally listed species (e.g., early life-stage Colorado pikeminnow and razorback sucker) because it is plausible that a single individual could be exposed to the maximum concentration throughout a critical life stage (e.g., fish eggs attached to river bed substrate). While it is recognized that even short-term continuous exposure to an immobile critical life-stage individual is unlikely, it is plausible that such exposure could occur at some time during the life of the Proposed Action. However, older life stages of listed species are less likely to be continually exposed to a maximum concentration due to larger foraging ranges and potential migration. For the assessment of mobile federally listed species, including the federally listed southwestern willow flycatcher and yellow-billed cuckoo, HQs based on 95% UCL media concentrations (an estimate of the average concentration with 95 percent confidence that the true mean concentration is less than this value) are applicable because exposure to mobile species is largely related to foraging behavior. The use of maximum media concentrations for mobile species would be unrealistic and would likely overestimate HQs. Use of the arithmetic average media concentration was included in the ERAs to help bound the assessment of potential effects to non-listed species and are not considered in this BA.

4. In several instances, the ERAs reported HQs that were based entirely on current conditions data for which COPECs were never detected and for which the EPC was assumed to be equal to either the lowest detection limit or the highest detection limit. For the BA, this approach was considered overly conservative and, thus, was not considered reliable and was not considered quantitatively. Such was the case for soil PAH exposure to plants where PAHs were not actually detected in the baseline soil dataset and, therefore, HQs were calculated based entirely on detection limits.

5. Terminology
   a. Environmental Baseline in the BA is assumed to be equivalent to Current Conditions in the ERAs.
   b. Project Effects in the BA are assumed to be equivalent to Deposition-Related Contributions in the ERAs.
   c. Cumulative Effects in the BA are assumed to be equivalent to Current Conditions + Deposition-Related Contributions in the Deposition Area ERA and to Scenario 8 Contributions in the San Juan River ERA. Scenario 8 represents past and present effects as corresponding to baseline conditions and the reasonably foreseeable future effects associated with the FCPP's proposed 25-year future operation, as well as contributions from other regional and global sources relating to the effects of arsenic, mercury, and selenium.

6. For potential risks to plants, the Deposition Area ERA evaluated generic plants using data representing the entire Deposition Area, but also evaluated special-status plants, including federally listed plants, using data representing only the areas within the Deposition Area where such plants were likely to occur based on habitat modeling. For the BA, only the HQs from habitat-based assessments were considered relevant.

7. The soil, water, sediment, and fish tissue data reported in the Deposition Area ERA for FCPP contributions represent the reasonably foreseeable future effects associated with the FCPP's proposed 25-year future operation, but do not take into account any other future actions. The San Juan River ERA future conditions are represented by Scenario 8, described above.

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The discussion of the ERA results in the remainder of this BA will focus only on the COPECs identified in the ERAs as having applicable HQs greater than 1. They are summarized in Section 6.2. For a discussion of other COPECs, the reader is referred to the ERA reports (AECOM 2013b,c).

4.4 Summary of Toxicity Information for COPECs with HQs > 1

4.4.1 Fish Critical Body Residues

The ERAs reported HQs exceeding 1, based on maximum tissue concentrations, for Colorado pikeminnow and razorback sucker for chromium, copper, mercury, lead, nickel, selenium, and zinc. The critical body residue, in units of milligrams per kilogram wet weight (mg/kg ww), is appropriately defined as the highest no-observable-effect-concentration (NOEC) that is less than the lowest lowest-observable-effect-concentration (LOEC). All NOECs used in the calculation of HQs in the ERAs are those most relevant to population level effects including mortality, growth, development, and reproduction. The ERAs also considered alternative critical body burdens for mercury and selenium (AECOM 2013b,c).

4.4.2 Avian Toxicity Reference Values

In contrast to the critical body residues for fish, which were derived using a common method for each COPEC, the derivation of TRVs for avian species followed a more complex process as described below. The ERAs reported HQs exceeding 1 for southwestern willow flycatcher and yellow-billed cuckoo for chromium, copper, lead, methylmercury, and selenium based on 95% UCL EPCs for Morgan Lake and the San Juan River. Avian receptors may experience a wide range of adverse effects from chemical exposures including biochemical and physiological responses, immunological effects, behavioral effects, deficiencies in growth, reproductive impairment, and mortality. In general, growth, reproduction, and mortality are the endpoints that are considered most relevant for assessing effects to populations. Reproductive effects tend to be among the most sensitive endpoints. In their derivation of TRVs, EPA (2005b) preferentially derives TRVs based on growth, reproduction, and survival toxicity data when such data are available. The derivation of the NOAEL TRVs for these COPECs are described in Table 4-1.

Table 4-1 Derivation of NOAEL TRVs for Avian Species

COPEC	NOAEL TRV (mg/kg-day)	Derivation
Chromium	2.66	Geometric mean of NOAELs for growth and reproduction from 10 studies (chicken, duck, and turkey) and is lower than the lowest bounded LOAEL for reproduction (EPA 2008).
Copper	4.05	Highest bounded NOAEL (based on reproductive effects in the chicken) that is lower than the lowest bounded LOAEL for survival, growth, and reproduction (EPA 2007b).
Lead	1.63	Highest bounded NOAEL (based on reproductive effects in the chicken) that is lower than the lowest bounded LOAEL for survival, growth, and reproduction (EPA 2005c).
Mercury	0.039	NOAEL estimated by application of uncertainty factor of 2 to the LOAEL of 0.078 mg/kg-day based on reproductive effects in mallards (DTSC 2000).
Methylmercury	0.0064	Single three-generation study of mallard ducks exposed to methylmercury dicyandiamide in the diet. A NOAEL was not identified in this study so a modifying factor of 0.1 was applied to the LOAEL-based TRV of 0.64 mg/kg-day. The LOAEL-based TRV was based on reproductive effects (fewer eggs and ducklings produced) (Sample et al. 1996).
Selenium	2.90	Highest bounded NOAEL (based on survival in the chicken) that is lower than the lowest bounded LOAEL for survival, growth, and reproduction (EPA 2007c).

4.4.3 Plant Toxicity Benchmarks

The Deposition Area ERA reported HQs exceeding 1 for Mancos milk-vetch and Mesa Verde cactus for boron, chromium, molybdenum, selenium, and vanadium. HQs for all these COPECs, except selenium, were calculated using soil benchmarks derived by Efroymson et al. (1997). The soil benchmark for selenium was taken from EPA (2007c). In all cases, soil benchmarks were based on toxicity studies in which the chemical was added to the soil such that metals may have been more bioavailable than under natural conditions. In all cases toxicity benchmarks were based on effect levels for plant growth. The soil toxicity benchmarks for plants are based on effects levels whereby an HQ of 1 corresponds to a likely adverse effect.

4.5 Uncertainties in the Ecological Risk Assessments

In general, the ERA process has numerous, inherent uncertainties. Many of these uncertainties are related to upper-bound assumptions and parameter values selected specifically to ensure that risks are not underestimated. The cumulative impact of multiple upper-bound assumptions is more likely to overestimate, than underestimate, potential risks to ecological receptors. Both ERAs presented detailed discussions of the uncertainties inherent in the process (AECOM 2013b,c). The key uncertainties most relevant to the evaluation of federally listed species addressed in this BA are summarized below:

1. EPCs for surface-water, soil, sediments, and fish tissue baseline conditions are often based on limited data. The uncertainties associated with estimating baseline exposures from these limited data could result in either overestimation or underestimation of baseline HQs.

2. The prediction of future effects associated with the Proposed Action, and other future actions, within the Deposition Area terrestrial environment and the San Juan River aquatic and riparian habit are based on air and watershed models, which in turn are based on numerous assumptions regarding future emissions and fate and transport processes. The uncertainties associated with air and watershed modeling could result in either overestimation or underestimation of HQs for the Proposed Action as well as other future actions for arsenic, mercury, and selenium. The assumptions made within the air and watershed models were based on the best available information about emissions and the environmental conditions within the Deposition Area.

3. Species-specific exposure data are not available for the federally listed birds and fish evaluated in the ERAs. Therefore, as is standard risk assessment practice, representative species were used as exposure surrogates for federally listed species. For birds, the estimated exposure (e.g., dose) is related largely to the amount of food ingested per day and body weight. Use of the willow flycatcher as the representative species for southwestern willow flycatcher is unlikely to introduce substantial uncertainty given the similarities in these species. The diet of yellow-billed cuckoo has a higher proportion of terrestrial insects than does the willow flycatcher, so more uncertainty is associated with the assessment for this species. The Deposition Area ERA found that terrestrial invertebrates had lower tissue concentrations of COPECs than did aquatic invertebrates. Therefore, this difference would suggest the HQs for yellow-billed cuckoo are overestimated. For exposure to federally listed fish, considerable uncertainty exists in the bioaccumulation factors used and the food-web modeling conducted. These uncertainties could result in overestimation or underestimation of HQs for the Proposed Action as well as other future actions for arsenic, mercury, and selenium.

4. Species-specific toxicity data are not available for federally listed plants, birds, or fish. The plant soil benchmarks used to calculate HQs are based largely on studies of vegetables grown in silty loamy soils. These studies are not representative of plants or habitat within the Deposition Area. The soil COPEC concentrations reported to correspond to adverse effects to plants generally fall within natural background concentrations in the U.S., indicating that the laboratory studies may overestimate toxicity to some natural plant communities that may tolerate or prefer higher levels

of some COPECs. The sandstone and shale substrate favored by Mancos milk-vetch and Mesa Verde cactus, respectively, appear to have naturally enriched concentration of some COPECs. Thus, the HQs for federally listed plants are likely overestimated. For birds, TRVs are based largely on studies of chickens. The extrapolation of toxicity in the chicken to southwestern willow flycatcher and yellow-billed cuckoo is uncertain and could result in either overestimation or underestimation of HQs. For fish, critical body burdens are mostly based on the highest NOEC for all species combined from multiple studies that is lower than the lowest LOEC for all species combined. Although the likelihood is greater that HQs were overestimated than underestimated, because no studies were actually conducted on Colorado pikeminnow or razorback sucker, it is not possible to definitely determine the direction of uncertainty.

5. The Deposition Area ERA evaluated cumulative effects based on baseline conditions and future emissions associated with the Proposed Action. For discussion in this BA, baseline conditions plus future FCPP emissions were assumed to represent the minimum cumulative effects because other future actions were not quantitatively considered due to a lack of information about potential future sources. Actual cumulative effects could be greater than expressed by the HQs related to baseline conditions plus future FCPP emissions, but the magnitude of this difference is unknown. Note that it is also possible that for some COPECs, future concentrations within the watershed could be lower than the data used to establish current conditions. Such decreases were noted for some COPECs between sampling conducted in the mid-1990s and sampling conducted in support of the ERAs.

6. The San Juan River ERA only evaluated effects to aquatic and riparian receptors within the San Juan River corridor from exposure to arsenic, mercury, and selenium. Several COPECs (e.g., chromium, copper, lead, zinc) not evaluated in the San Juan River ERA were found to have elevated HQs in the Deposition Area ERA for exposure to aquatic or riparian receptors. Thus, for the San Juan River downstream of the Deposition Area and into the San Juan River arm of Lake Powell, uncertainty exists in potential risk posed by these COPECs.

As discussed above, numerous uncertainties are inherent to the ERA process. In general, ERAs utilize a mix of parameter values and assumptions that include best estimates as well as upper-bound estimates to ensure that the ERA favors protection by overestimation of risk rather than underestimation of risk.

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5 Species Life History and Habitat

OSMRE obtained a list of species to be considered during this consultation from IPaC and the Arizona USFWS website (www.fws.gov/southwest/es/endangeredspecies/lists/) on January 23, 2014 (Appendix A). The result was a total of 39 species with the potential to occur within the Action Area. OSMRE reviewed this list and determined that no effect would occur to 30 species because the known distribution of these species does not overlap the Action Area, the Action Area does not support suitable habitat for those species, or the Proposed Action would have no effect on these species. Justification for exclusion of these species from the consultation is provided in Appendix B.

OSMRE determined that the Proposed Action has the potential to affect nine species:

- Colorado pikeminnow (*Ptychocheilus lucius*) - Endangered
- Razorback sucker (*Xyrauchen texanus*) - Endangered
- Southwestern willow Flycatcher (*Empidonax traillii extimus*) - Endangered
- Yellow-billed cuckoo (*Coccyzus americanus*) - Proposed Threatened
- California condor (Gymnogyps californianus) – Endangered, experimental population
- Mexican spotted owl (*Strix occidentalis lucida*) - Threatened
- Mancos milk-vetch (*Astragalus humillimus*) - Endangered
- Mesa Verde cactus (*Sclerocactus mesae-verdae*) – Threatened
- Fickeisen plains cactus (*Pediocactus peeblesianus* var. *fickeiseniae*) -Endangered

Designated critical habitat for Colorado pikeminnow, razorback sucker, and Fickeisen plains cactus occurs within the Action Area. The effects of the Proposed Action on the habitats for these species are considered in the remainder of this BA. Critical habitat has been designated for southwestern willow flycatcher, California condor, and Mexican spotted owl, but does not lie within the Action Area. Critical habitat has not been designated for yellow-billed cuckoo, Mancos milk-vetch, or Mesa Verde cactus.

5.1 Colorado Pikeminnow

5.1.1 Species Description

Colorado pikeminnow (*Ptychocheilus lucius*) is the largest cyprinid fish endemic to the Colorado River Basin. Historically, adults attained a maximum size of about 6 feet (1.8 meter) total length (TL) and 80 pounds (36 kilograms [kg]) in weight. Today, Colorado pikeminnow rarely exceed approximately 3 feet (1 meter) in length or weigh more than 18 pounds (8 kg).

Colorado pikeminnow is a member of a unique assemblage of fishes native to the Colorado River Basin, consisting of 35 species with 74 percent level of endemism. It is one of four mainstem, big-river fishes currently listed as endangered under the ESA; others are the humpback chub (*Gila cypha*), bonytail chub(*Gila elegans*), and razorback sucker (*Xyrauchen texanus*). The native fish assemblage of the Colorado River Basin is jeopardized by large mainstem dams, water diversions, habitat modification, non-native fish species, and degraded water quality (USFWS 2002a).

Based on early fish collection records, archaeological finds, and other observations, Colorado pikeminnow was once found throughout warm-water reaches of the entire Colorado River Basin down to the Gulf of California, including reaches of the upper Colorado River and its major tributaries, the Green River and its major tributaries, the San Juan River and some of its tributaries, and the Gila River system

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in Arizona (Quartarone and Young 1995). Colorado pikeminnow apparently were never found in colder, headwater areas. The species was abundant in suitable habitat throughout the entire Colorado River Basin prior to the 1850s. By the 1970s they were extirpated from the entire lower basin (downstream of Glen Canyon Dam) and from portions of the upper basin because of major alterations to the riverine environment. Having lost approximately 75 to 80 percent of its former range, Colorado pikeminnow was added to the list of endangered species in 1967 (USFWS 2002a).

5.1.2 Life History

Information relating to the life history of and population status of Colorado pikeminnow was derived primarily from the 2002 Colorado pikeminnow Recovery Goals (USFWS 2002a) and documents available through the SJRRIP (http://www.fws.gov/southwest/sjrip/). Other references are noted in the text.

Colorado pikeminnow is the largest member of the minnow family native to North America. The top predator in the Colorado River system, it is an elongated pike-like fish.

The species is adapted to a hydrologic cycle characterized by large spring peaks of snowmelt runoff and low, relatively stable base flows. High spring flows create and maintain in-channel habitats, and reconnect floodplain and riverine habitats. Throughout most of the year, juvenile, subadult, and adult Colorado pikeminnow utilize relatively deep, low-velocity eddies, pools, and runs that occur in nearshore areas of main river channels). In spring, however, Colorado pikeminnow adults utilize floodplain habitats, flooded tributary mouths, flooded side canyons, and eddies that are available only during high flows. Such environments may be particularly beneficial for Colorado pikeminnow because other riverine fishes gather in floodplain habitats to exploit food and temperature resources, and may serve as prey. Such low-velocity environments also may serve as resting areas for Colorado pikeminnow. River reaches of high habitat complexity appear to be preferred.

Colorado pikeminnow is a long-distance migrator. Adults can move hundreds of miles to and from spawning areas and require long sections of river with unimpeded passage. Adults are generally considered to be individuals 1.5 feet (450 millimeters [mm]) or greater in length. Hatchery-reared males become sexually mature at 4 years of age, while hatchery-reared females become mature at 5 years of age.

Colorado pikeminnow requires relatively warm temperatures for spawning, egg incubation, and survival of young. Spawning occurs after spring runoff at water temperatures typically between 64 and 73°F (18 and 23 degrees Celsius [°C]), generally from late June to late August. Colorado pikeminnow broadcast spawn over areas of gravel and cobble. The eggs are demersal (sink to the bottom) and incubate in the interstitial spaces in the substrate. Eggs hatch in 4 or 5 days, with some variation relating to water temperature. Hatching success is greatest at temperatures of 68 to 75°F (20 to 24°C). After hatching and emerging from spawning substrate, larvae drift downstream to nursery backwaters in sandy, alluvial areas, where they remain through the first year of life. Studies on the Yampa River indicate that larvae may drift 50 to 120 miles downstream to nursery areas. Ideal backwaters are large, warm, and deep, often formed when a secondary channel is cut off from the main channel at its head end, but remains connected to the river at its outlet. These backwaters are restructured by high spring flows and maintained by relatively stable base flows. These ideal rearing habitats are uncommon on the San Juan River (Bleisner et al. 2008; SWCA 2012; B. Miller, pers. comm., 2013). Young Colorado pikeminnow remain near nursery areas for the first 2 to 4 years of life and, then, move upstream to recruit to adult populations and establish home ranges.

Colorado pikeminnow less than 2 inches (50 mm) long eat primarily cladocerans, copepods, and midge larvae. Insects become less important as fish exceed 2 inches, with fish becoming more important as the fish grows. The diet of Colorado pikeminnow longer than 3 or 4 inches (80 to 100 mm) consists almost entirely of other fishes.

Adults require pools, deep runs, and eddy habitats maintained by high spring flows. These high spring flows maintain channel and habitat diversity, form gravel and cobble deposits used for spawning and flush sediments from these areas, stimulate food production, and freshen backwater nursery habitats.

Survival and recruitment of Colorado pikeminnow is episodic and tied to high spring flows. Long-lived species, such as Colorado pikeminnow, can survive episodic recruitment events because of their longevity and high fecundity. Adults spawn multiple times allowing the population to weather periods of low recruitment success. Following years with high spring flow, high recruitment and cohort strength is observed (USFWS 2002a). The greatest cohort strength on the upper Colorado and Green rivers occurred 1 to 2 years after high river flows. Recruitment may not be high in the year in which a high flow occurs because of delayed spawning due to cooler water temperatures.

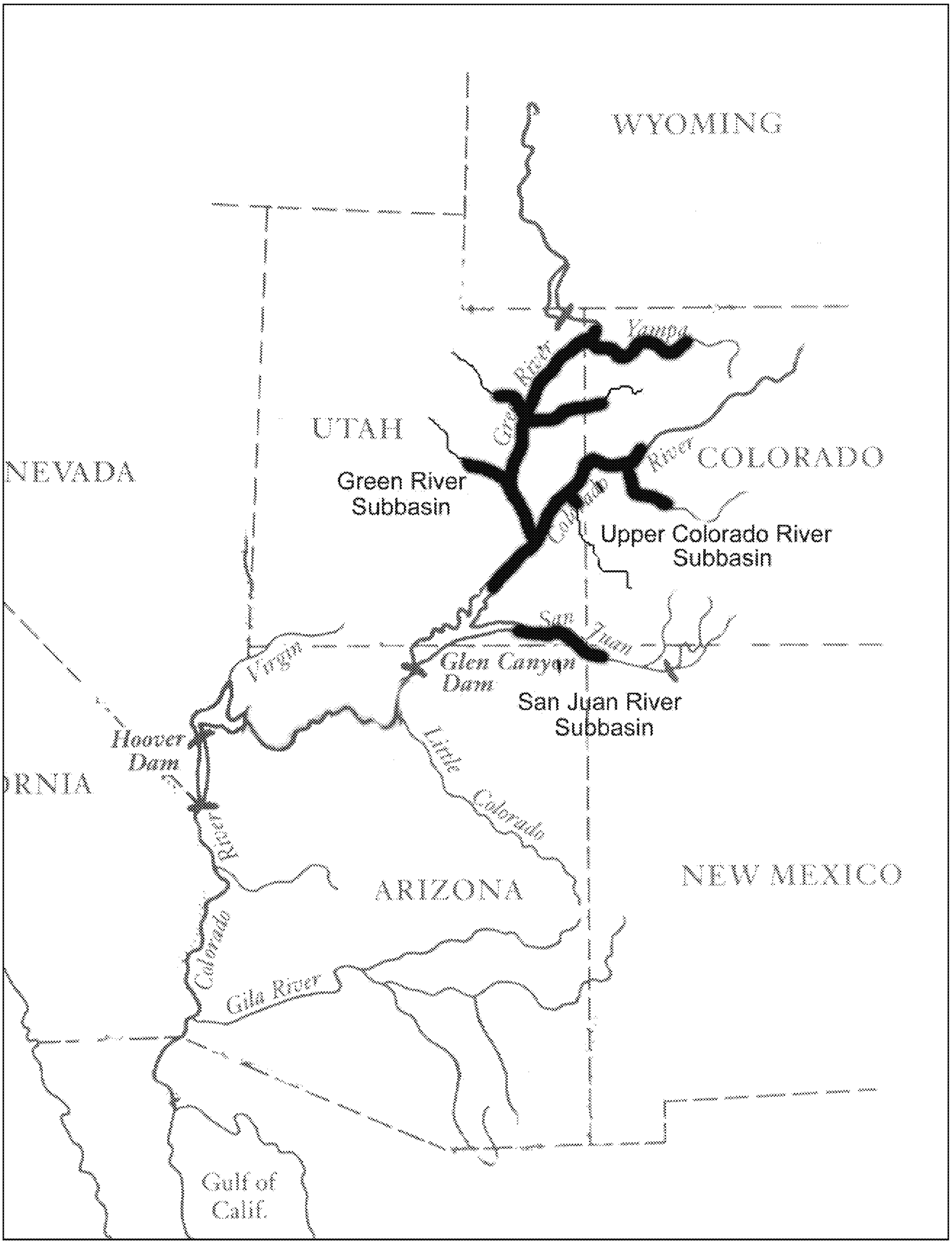
5.1.3 Population Dynamics

Bestgen et al. (2010) report that adult Colorado pikeminnow abundance in the Green River system generally increased between 2006 and 2008. While the estimates overlapped greatly among years, a consistent increasing trend in most segments over time indicates increasing abundance. They also reported that the number of recruits (400- to 449-mm fish) also increased over this period. However, while they concluded the number of Colorado pikeminnow seemed to be increasing for the river as a whole, it decreased relative to abundance estimates from 2000 and 2001 in the Yampa River and the riverwide number of juveniles (<400 mm) appeared to decline between 2006 and 2008.

Osmundson and White (2009) report that the number of individuals ≥ 450 mm long in the upper Colorado River increased from about 200 in 1991 to 889 in 2005, a four-fold increase. The number of fish about to recruit into the adult class also increased over time and exceeded the estimated adult mortality, although the precision associated with this measure was low. Recruitment appeared to exceed adult mortality in 6 of 9 years sampled.

5.1.4 Status and Distribution

Colorado pikeminnow is currently listed as "endangered" under the ESA of 1973, as amended (16 USC 1531 et. seq.). It was first included in the List of Endangered Species issued by the Office of Endangered Species on March 11, 1967 (32 Federal Register [FR] 4001), and was considered endangered under provisions of the Endangered Species Conservation Act of 1969 (16 USC 668aa). The Colorado squawfish (pikeminnow) was included in the United States List of Endangered Native Fish and Wildlife issued on June 4, 1973 (38 FR No. 106), and it received protection as endangered under Section 4(c)(3) of the original ESA of 1973. The initial Colorado Squawfish (pikeminnow) Recovery Plan was approved on August 6, 1991, and was amended and supplemented in 2002. The final rule for determination of critical habitat was published on March 21, 1994 (59 FR 13374), and the final designation became effective on April 20, 1994 (USFWS 2002a). A 5-year review of the species was published in 2011 (USFWS 2011a). Three populations are recognized: the Green River, the Upper Colorado River, and the San Juan River (Figure 5-1).



Source USFWS 2002a

Figure 5-1 Distribution of Wild Colorado Pikeminnow in the Colorado River Basin

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5.1.4.1 *Recovery Goals*

Recovery goals for Colorado pikeminnow are as follows (USFWS 2002a; UCREFRP 2014a).

Colorado pikeminnow will be considered eligible for downlisting from "endangered" to "threatened" and for removal from ESA protection (delisting) when all of the following conditions are met:

- Self-sustaining fish populations reach the required numbers in areas of the Green, Colorado, and/or San Juan rivers as identified in the chart below.
- The threat of significant "fragmentation" of the population has been removed. (Fragmentation refers to separation between fish populations caused by geographical distance or physical barriers.)
- Essential habitats, including primary migration routes and required stream flows, are legally protected.
- Other identifiable threats that could significantly affect the population are removed.

Demographic Criteria For Recovery	
Downlisting Colorado Pikeminnow	**Delisting Colorado Pikeminnow**
Over a 5-year monitoring period: • Maintain the upper basin metapopulation • Maintain populations in Green River and upper Colorado River subbasins ("no net loss") • Green River subbasin population > 2,600 adults • Upper Colorado River subbasin population > 700 adults • Establish 1,000 age-5+ subadults in San Juan River	For 7 years beyond downlisting: • Maintain the upper basin metapopulation • Maintain populations in Green River and upper Colorado River subbasins ("no net loss") • Green River subbasin population > 2,600 adults • Upper Colorado River subbasin population > 1,000 adults OR Upper Colorado River subbasin population > 700 adults and San Juan River population > 800 adults

5.1.5 Critical Habitat

Critical habitat was designated for Colorado pikeminnow in 1994 within the 100-year floodplain of the species' historical range in the Green, Upper Colorado, and San Juan River basins (59 FR 13374). In the San Juan River Basin, this habitat includes the San Juan River from New Mexico State Route 371 near Farmington, New Mexico, to the full pool elevation at the mouth of Neskahai Canyon on the San Juan arm of Lake Powell.

The PCEs of Colorado pikeminnow critical habitat (59 FR 13374) include:

- *Water*: enough water of sufficient quality delivered to habitats in accordance with a hydrologic regime that is required for the particular life stage for the species
- *Physical Habitat*: areas of the Colorado River system that are inhabited or potentially habitable for spawning and feeding, as a nursery, or as corridors between these areas, including oxbows, backwaters, and other areas in the 100-year floodplain, which when inundated provide access to spawning, nursery, feeding, and rearing habitats
- *Biological Environment*: adequate food supply and ecologically appropriate levels of predation and competition

5.1.6 Identified Threats

The Colorado Pikeminnow Recovery Plan (USFWS 2002a) identifies four primary threats to Colorado pikeminnow: streamflow regulation, habitat modification, competition and predation with non-native fish, and pesticides and pollutants.

5.1.6.1 Streamflow Regulation and Habitat Modification

Numerous dams, diversion, weirs, and other water management structures have been built in the Colorado River Basin since 1935. These dams have altered flow volume and seasonality, largely eliminated spring peak flows needed to maintain habitat and provide access to overbank areas, reduced habitat complexity, altered temperature and sediment transport regimes, and altered water quality. These structures also fragmented habitat, creating impassible barriers to migration, fragmenting habitat and blocking access between upstream spawning areas and downstream nursery areas. Additionally, approximately 420 miles (700 kilometers [km]) of riverine habitat has been inundated by reservoirs in the upper basin. Temperatures below dams are typically cool due to hypolimnetic releases and may not reach equilibrium with atmospheric temperatures for many tens or hundreds of miles downstream (over 60 miles [100 km] on the San Juan River) (USFWS 2002a).

5.1.6.2 Competition and Predation

The Colorado River Basin has numerous non-native fish that may compete with or prey upon Colorado pikeminnow and other native species, or serve as vectors for parasites and disease (USFWS 2002a). A number of these species occupy the backwaters and other low-velocity habitats required by larval and juvenile Colorado pikeminnow where they may compete for food and space. Various species have been documented to prey on young-of-year and juvenile pikeminnow, including black bullhead (*Ameiurus melas*), green sunfish (*Lepomis cyanellus*), largemouth bass (*Micropterus salmoides*), and black crappie (*Pomoxis nigromaculatus*). Channel catfish (*Ictalurus punctatus*) have been identified as another significant predator in the San Juan River. Red shiner (*Cyprinella lutrensis*) have also been identified as a predator on larval fish (USFWS 2002a; Gerig and Hines 2013; Duran et al. 2013).

Reservoirs in the systems occupied by Colorado pikeminnow support non-native fish that may prey on or compete with native fish, including Colorado pikeminnow. Reservoirs and the stable flow and temperature conditions created by dams provides highly suitable habitat for these species, which gives them a competitive advantage over native fish that have evolved under more dynamic, riverine conditions. Reservoirs serve as a source of these predators. Non-native fish control programs have been implemented in several areas within the basin. While these programs have met with some success, non-native species persist. Flow management actions, including provision of high spring flows to reduce non-native fish populations, have been implemented in some areas, and stocking agreements have been made to limit the accidental introduction of non-native species into natural waterways (USFWS 2002a).

5.1.6.3 Disease

Non-native fish are potential vectors for parasites and disease (USFWS 2002a). These species may bring new diseases and parasites into the system to which native fish are not adapted, potentially leading to catastrophic impacts on native species. Additionally, the abundance of non-native fish within the system may serve to promote the transmittal of disease or parasites.

5.1.6.4 Inadequacy of Existing Regulatory Mechanisms

The Recovery Plan identified that additional regulatory mechanisms needed to be implemented to ensure long-term conservation of the species. These mechanisms affect the protection and restoration of habitat, flow, regulation and control of non-native fishes, protection from release of hazardous materials, and angling regulations. Many efforts in this regard have been made since the Recovery Plan was published in 2002 (USFWS 2011a). Flow regimes intended to provide for the needs of listed native species have been developed for many river segments, including the San Juan River; non-native species control efforts have been implemented, agreements have been reached with regard to the stocking of non-native fish (USFWS 2002a).

5.1.6.5 Other Natural or Man-Made Factors

Pollutants have also been identified as a potential factor affecting populations of native fish, including Colorado pikeminnow. Populations are susceptible to the spill of hazardous materials into their habitats, especially if such spills occur in unique habitats, such as spawning areas, which Colorado pikeminnow use consistently from year to year. Pesticide and industrial runoff may also affect the species. Sampling within the San Juan River has identified mercury as a particular concern for Colorado pikeminnow. Selenium concentrations are also elevated within the basin, potentially affecting other native fish (USFWS 2002a).

5.1.7 San Juan River Restoration Implementation Program

The SJRRIP's purpose is to protect and recover endangered fishes in the San Juan River Basin while water development proceeds in compliance with all applicable federal and state laws (http://www.fws.gov/southwest/sjrip/GB_GOP.cfm, accessed 04/13/2014). Endangered species include Colorado pikeminnow (formerly known as Colorado squawfish) and razorback sucker. It is anticipated that actions taken under the SJRRIP will also provide benefits to other native fishes in the basin and prevent them from becoming endangered in the future.

The SJRRIP's specific goals are to:

- Conserve populations of Colorado pikeminnow and razorback sucker in the Basin consistent with recovery goals established under the ESA (16 USC 1531 et seq).
- To proceed with water development in the Basin in compliance with federal and state laws, interstate compacts, Supreme Court decrees, and federal trust responsibilities to the Southern Utes, Ute Mountain Utes, Jicarillas, and the Navajos.

The SJRRIP's main elements include:

- **Protection of genetic integrity and management and augmentation of populations** involves completing genetics management and augmentation plans, establishing refugia with stock taken from the wild, and augmenting wild populations of endangered fish species.
- **Protection, management, and augmentation of habitat** involves identifying important reaches of the San Juan River for different life stages of the endangered fish species by mapping current conditions, determining relationships between flow and habitat, and determining flow needs. In addition, augmentation of habitat includes providing fish passage around migration barriers.
- **Water quality protection and enhancement** involves monitoring existing water quality conditions, evaluating historic information, identifying types and sources of contamination, investigating changes in water chemistry, and pursuing actions to diminish or eliminate water quality problems that limit recovery.
- **Interactions between native and nonnative fish species** involves determining the distribution and abundance of non-native species, identifying and characterizing habitats used by the non-native fish, discontinuing stocking of non-native species in areas where endangered fish occur, and control of non-natives through removal efforts.
- **Monitoring and data management** is necessary to evaluate status and trends of endangered fish species as well as other native and non-native species to assure the Recovery Program's overall success in achieving recovery goals (http://www.fws.gov/southwest/sjrip/GB_PE.cfm, accessed 04/14/2014).

Nothing in the SJRRIP shall be construed to affect the right to use water under any federal or state law or permit, federal contract, treaty, interstate compact, or the right of any party in any adjudication proceeding to determine rights to use water or to contract for water.

This SJRRIP is intended to provide the means for conserving the endangered fish species in the San Juan River Basin while water development proceeds consistent with applicable laws. The order in which water development occurs may not necessarily reflect the priority of the water rights. Therefore, the successful development of any water project in accordance with the SJRRIP does not create a water right for project beneficiaries or its contractors to the use of water greater or lesser than those to which the project beneficiaries or contractors would otherwise be entitled, nor would such development of a project adversely affect the water rights of any other water users or water right holders in the Basin.

5.2 Razorback Sucker

5.2.1 Species Description

Razorback sucker is a member of the sucker family, Catostomidae, and is endemic to the Colorado River Basin. It is distinctive because of the abrupt sharp-edged dorsal keel behind its head. The head and keel are dark, the back is olive-colored, and the abdomen is yellow. Adults often exceed 6 pounds (4 kg) in weight and 2 feet (600 mm) in length. This species may live over 30 years (USFWS 2002b).

The species was historically found in warm-water reaches of the larger rivers of the Colorado River Basin from Mexico to Wyoming. Its current distribution includes portions of the Green, Yampa, White, Duchesne, upper Colorado, Gunnison, and San Juan rivers in the Upper Colorado River Basin. It is also found in Lake Mohave, Lake Mead, and in the lower Colorado River from Lake Havasu to Davis Dam, and has been stocked into the Verde and Salt rivers in the Lower Colorado River Basin. Within the San Juan River Basin, it has been observed from Lake Powell, to upstream of the Animas River (USFWS 2002b).

5.2.2 Life History

Adult razorback sucker use deep runs, eddies, backwaters, and flooded off-channel areas in the spring; runs and pools during the summer; and low-velocity runs, pools, and eddies in the winter. This species makes short- to long-range migrations to spawn in the spring, and young are dispersed downstream by flow. Spawning typically occurs in broad alluvial, flatwater regions at temperatures more than 57°F (14°C) (range 43 to 66°F [6 to 19°C]) and occurs over cobble, gravel bars, and sandbars. Spawning has been observed to occur from mid-April through June on ascending limb of the hydrograph. Females may produce about 18,000 eggs per pound (39,600 eggs per kg), with the average female being about 6.5 pounds (3 kg). Eggs are adhesive and settle to substrate, where they incubate in the interstitial spaces. Razorback sucker may also spawn in reservoirs over rocky shoals or shorelines. Preferred temperatures for spawning are around 68°F (20°C), with poor success when temperatures drop to 50°F (10°C) or rise to 86°F (30°C). Young fish require low-velocity, warm, shallow habitats, associated with backwaters, tributary mouths, and side channels. Young may stay in these areas for several weeks before dispersing to deeper water. Historically flooded bottomland habitats may have been important rearing habitats, but these habitats are much less available because of flood control.

Non-native fish are thought to play an important role in the decline of razorback sucker (USFWS 2002b). Many non-native species have been thought to prey on or compete with razorback sucker, including red shiner, common carp, fathead minnow, channel catfish, northern pike, green sunfish white sucker, black bullhead, smallmouth bass, largemouth bass, and sand shiner (USFWS 2002b). These species may also be vectors for disease or parasites.

All life stages of razorback sucker consume insects, zooplankton, phytoplankton, algae and detritus, although food preference differs with eggs, with larval fish depending more on zooplankton and older fish consuming more benthic items.

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5.2.3 Population Dynamics

Razorback sucker can live over 30 years (USFWS 2002b), but little to no natural recruitment has been observed in Upper Basin monitoring efforts. Razorback sucker are currently found in small numbers in the Green River, upper Colorado River, and San Juan River subbasins; lower Colorado River between Lake Havasu and Davis Dam; reservoirs of Lakes Mead and Mohave; and in small tributaries of the Gila River subbasin (Verde River, Salt River, and Fossil Creek).

The largest number of wild razorback sucker remaining occur in Lake Mohave. This stock has dwindled from 60,000 in 1991 to an estimated 3,000 in 2001. This population has been characterized as senescent and little recruitment has occurred. Natural populations in the remainder of the Colorado system are not self-sustaining. In the upper Colorado River, the number of adult fish was reported to be around 500 in 1996 (USFWS 2002b).

All populations, except the one in Lake Mead, are currently supported through hatchery supplementation (UCREFRP 2014b). Significant numbers of hatchery-reared razorback sucker do survive 1 or more years after release, with some fish surviving up to 15 years. Evidence exists that these stocked fish do spawn. However, little recruitment of Age 1 and Age 2 fish appears to occur, although these age classes are difficult to sample (Bestgen et al. 2012; Schleicher and Ryden 2013).

No wild razorback sucker were observed in the San Juan River Basin during 7 years of monitoring form 1991 to 1997. Stocking has been ongoing since 1994 (Furr 2013) and the SJRRIP has documented these stocked razorback sucker in the San Juan River from upstream of the Animas River confluence downstream to Lake Powell (Ryden 2012; Gilbert el al. 2012). These stocked fish have been documented to survive into subsequent years and reproduced, as indicated by larval fish collections (Brandenburg et al. 2012).

5.2.4 Status and Distribution

Razorback sucker was listed as endangered under the ESA in 1991 (56 CFR 54957). Critical habitat was designated along with other native Colorado River Basin fish species in 1994 (59 CFR 13374). A recovery plan for the species was first published in 1998 and was most recently amended and supplemented in 2002 (USFWS 2002b). A 5-year review of the species was published in 2012 (USFWS 2012a).

Historically, razorback sucker occupied the mainstem Colorado River and many of its tributaries from northern Mexico through Arizona and Utah into Wyoming, Colorado, and New Mexico. In the late 19th and early 20th centuries, it was reported as being abundant in the Lower Colorado River Basin and common in parts of the Upper Colorado River Basin, with numbers apparently declining with distance upstream. In the lower basin, razorback sucker were found in abundance in the lower Colorado River from the delta in Mexico north to what is now Lake Mohave in Arizona, and in the Gila, San Pedro, Verde, and Salt rivers. Historic distribution of razorback sucker in the upper basin included the Colorado, Green, and San Juan River drainages (USFWS 2002b).

Distribution and abundance of razorback sucker declined throughout the 20th century over all of its historic range, and the species now exists naturally only in a few small, discontiguous populations or as dispersed individuals. These fish have exhibited little natural recruitment in the last 40 to 50 years, and wild populations are composed primarily of aging adults, with steep declines in numbers. Reproduction occurs, but very few juveniles are found. Figure 5-2 shows the distribution of wild and stocked razorback sucker in the Colorado River Basin (USFWS 2002b).

Figure 5-2 Current Distribution of Wild and Stocked Razorback Sucker in the Colorado River System (USFWS 2002b)

5.2.4.1 Recovery Goals

Razorback sucker will be considered eligible for downlisting from "endangered" to "threatened" and for removal from ESA protection (delisting) when all of the following conditions are met (USFWS 2002b; UCREFRP 2014b):

- Self-sustaining fish populations reach the required numbers in areas of the Green River subbasin and EITHER the Colorado River subbasin or San Juan River, and the Lower Colorado River Basin, and a genetic refuge is maintained in Lake Mojave as identified in the chart below.
- The threat of significant "fragmentation" of the population has been removed. (Fragmentation refers to separation between fish populations caused by geographical distance or physical barriers.)
- Essential habitats, including primary migration routes and required stream flows, are legally protected.
- Other identifiable threats that could significantly affect the population are removed.

Demographic Criteria For Recovery	
Downlisting Razorback Sucker	**Delisting Razorback Sucker**
Over a 5-year monitoring period: • Maintain reestablished populations in Green River subbasin and EITHER in upper Colorado River subbasin or in San Juan River, each > 5,800 adults • Maintain established genetic refuge of adults in Lake Mohave • Maintain two reestablished populations in lower basin, each > 5,800 adults	For 3 years beyond downlisting: • Maintain populations in Green River subbasin and EITHER in upper Colorado River subbasin or in San Juan River, each > 5,800 adults • Maintain genetic refuge of adults in Lake Mohave • Maintain two populations in lower basin, each > 5,800 adults

5.2.5 Critical Habitat

Critical habitat for razorback sucker has been designated in 15 reaches of the Colorado River system encompassing 1,724 miles of river. In the Upper Basin, this habitat includes portions of the Green, Yampa, Duchesne, Colorado, White, Gunnison, and San Juan rivers. In the Lower Basin, it includes portions of the Colorado, Gila, Salt and Verde rivers (59 FR 13374). In the San Juan River, critical habitat has been designated from Hogback Diversion downstream to Lake Powell.

The PCEs of razorback sucker critical habitat include:

- Water: enough water of sufficient quality delivered to habitats in accordance with a hydrologic regime that is required for the particular life stage for the species
- Physical habitat: areas of the Colorado River system that are inhabited or potentially habitable for spawning and feeding, as a nursery, or as corridors between these areas, including oxbows, backwaters, and other areas in the 100-year floodplain which when inundated provide access to spawning, nursery, feeding, and rearing habitats
- Biological environment: adequate food supply and ecologically appropriate levels of predation and competition

In determining areas to be designated as critical habitat for razorback sucker the USFWS considered:

- The presence of known or suspected wild spawning populations
- Areas where juvenile razorback suckers have been collected or which could provide suitable nursery habitat
- Areas presently occupied or that were historically occupied that are considered necessary for recovery and have the potential for reestablishment of razorback suckers
- Areas and water required to maintain range-wide fish distribution and diversity under a variety of physical, chemicals, and biological conditions
- Areas that need special management or protection to insure razorback survival and recovery. This may include areas that once met their habitat needs and may be recoverable

5.2.6 Identified Threats

Threats to razorback sucker were identified in the species recovery plan (USFWS 2002b) and include streamflow regulation, habitat modification, competition with and predation by non-native fish, pesticides, and pollutants. These threats are the same as those described for Colorado pikeminnow.

5.3 Southwestern Willow Flycatcher

5.3.1 Species Description

Southwestern willow flycatcher (*Empidonax traillii extimus*) is a small grayish-green passerine bird measuring approximately 5.75 inches (14.5 centimeters [cm]) in height. It has a grayish-green back and wings, whitish throat, light gray-olive breast, and pale yellowish belly. Two white wingbars are visible in adults, while juveniles have buffy wingbars. The eye ring is faint or absent. The upper mandible is dark, and the lower is light yellow grading to black at the tip. The song is a sneezy "fitz-bew" or a "fit-a-bew" and the call is a repeated "whitt" (USFWS 2002c).

Southwestern willow flycatcher is one of four currently recognized willow flycatcher subspecies: little willow flycatcher (*Empidonax traillii brewsteri*) and three southwestern willow flycatchers (*E. t. extimus*, *E. t. adastus*, and *E. t. traillii*). Southwestern willow flycatcher is a neotropical migrant that breeds in the southwestern U.S. and migrates to Mexico, Central America, and possibly northern South America during the non-breeding season. The historic breeding range of southwestern willow flycatcher included southern California, Arizona, New Mexico, western Texas, southwestern Colorado, southern Utah, extreme southern Nevada, and extreme northwestern Mexico (USFWS 2002c).

5.3.2 Life History

Southwestern willow flycatcher breeds in dense riparian habitat from sea level in California to approximately 8,500 feet (2,600 meters) in elevation in Arizona and southwestern Colorado. Historical eggs/nest collections and species descriptions throughout its range describe widespread use of willow (*Salix* spp.) for nesting (USFWS 2002c). Southwestern willow flycatchers primarily occur along or near rivers, swamps, wetlands, lakes, areas supporting moist soils, and riparian habitats consisting of Geyer's willow (*Salix geyeriana*), coyote willow (*Salix exigua*), Goodding's willow (*Salix gooddingii*), boxelder (*Acer negundo*), salt cedar (*Tamarix* sp.), Russian olive (*Elaeagnus angustifolia*), and live oak (*Quercus agrifolia*) for nesting. Other plant species less commonly used for nesting include buttonbush (*Cephalanthus* sp.), black twinberry (*Lonicera involucrata*), cottonwood (*Populus* spp.), white alder (*Alnus rhombifolia*), blackberry (*Rubus* spp.), and stinging nettle (*Urtica* spp.). Salt cedar is an important component of nesting and foraging habitat in Arizona and other parts of the species' range. Four habitat types have been described for southwestern willow flycatcher: monotypic willow, monotypic exotic, native broadleaf dominated, and mixed native/exotic

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(Durst et al. 2008). Southwestern willow flycatcher foraging includes capture and consumption of insects throughout the year and some small berries during fall.

Southwestern willow flycatcher habitat is dynamic and can change rapidly; nesting habitat can mature beyond habitat suitable for nesting, suitable salt cedar habitat can develop in 5 years, heavy runoff can reduce or remove suitable habitat in a day, or river characteristics may change. Southwestern willow flycatcher use of habitat in different successional stages may also be dynamic. For example, over-mature or young habitat not suitable for nest placement can be occupied and used for foraging and shelter by migrating, breeding, dispersing, or non-territorial individuals (Durst et al. 2008). That same habitat may subsequently grow or cycle into habitat used for nest placement. Southwestern willow flycatcher habitat can quickly change and vary in suitability, location, use, and occupancy over time (USFWS 2002c).

5.3.3 Population Dynamics

Since the mid-1900s, populations of southwestern willow flycatcher have declined rapidly (USFWS 2002c). As of 2007, 1,299 known territories were known within 288 breeding sites throughout southwestern willow flycatcher's range in Arizona, California, Colorado, New Mexico, Texas, and Utah. Of the 1,299 territories, 930 were surveyed in 2007 and the remaining 369 had been surveyed in 2006 or earlier (Durst et al. 2008). Short-term studies on southwestern willow flycatcher have shown either a decline in population or no trend (USFWS 2002c).

5.3.4 Status and Distribution

Southwestern willow flycatcher was listed as endangered in 1995 (60 FR 10694; USFWS 2002c) and is presently listed under the Navajo Nation Endangered Species List (NESL) as a G2 species. At the time of federal listing, the final designation of critical habitat was deferred, pursuant to 16 USC 1533(b)(6)(C), citing issues identified in public comments, new information, and the lack of the information necessary to perform an economic analysis.

The final recovery plan for southwestern willow flycatcher was issued in 2002. The plan describes the reasons for endangerment and status of southwestern willow flycatcher, defines important recovery actions, includes detailed issue papers on management issues, and provides recovery goals. Recovery is based on reaching numerical and habitat-related goals for each specific management unit established throughout the subspecies range and establishing long-term conservation plans (USFWS 2002c).

Since listing in 1995, at least 155 federal agency actions have undergone (or are currently under) formal Section 7 consultation to address effects to the species. Many activities continue to adversely affect the distribution and extent of all stages of southwestern willow flycatcher habitat throughout its range (development, urbanization, grazing, recreation, native and non-native habitat removal, dam operations, river crossings, ground- and surface-water extraction, etc.).

The historical breeding range of southwestern willow flycatcher included southern California, southern Nevada, southern Utah, Arizona, New Mexico, western Texas, southwestern Colorado, and extreme northwestern Mexico (Figure 5-3). The flycatcher's current range is similar to the historical range, but the quantity of suitable habitat within that range is much reduced from historical levels. The flycatcher occurs from near sea level to over 8,500 feet (2,600 meters), but is primarily found in lower elevation riparian habitats. Throughout its range, the flycatcher's distribution follows that of its riparian habitat; relatively small, isolated, widely dispersed locales in a vast arid region. In some parts of its northern range, questions of range boundaries between other willow flycatcher subspecies exist, including possible intergradations between subspecies. In California individuals of *E. t. extimus* and *E. t. brewsteri* are morphologically fairly distinct, even where their ranges are near one another. Southwestern willow flycatcher's wintering range includes southern Mexico, Central America, and probably South America (USFWS 2002c).

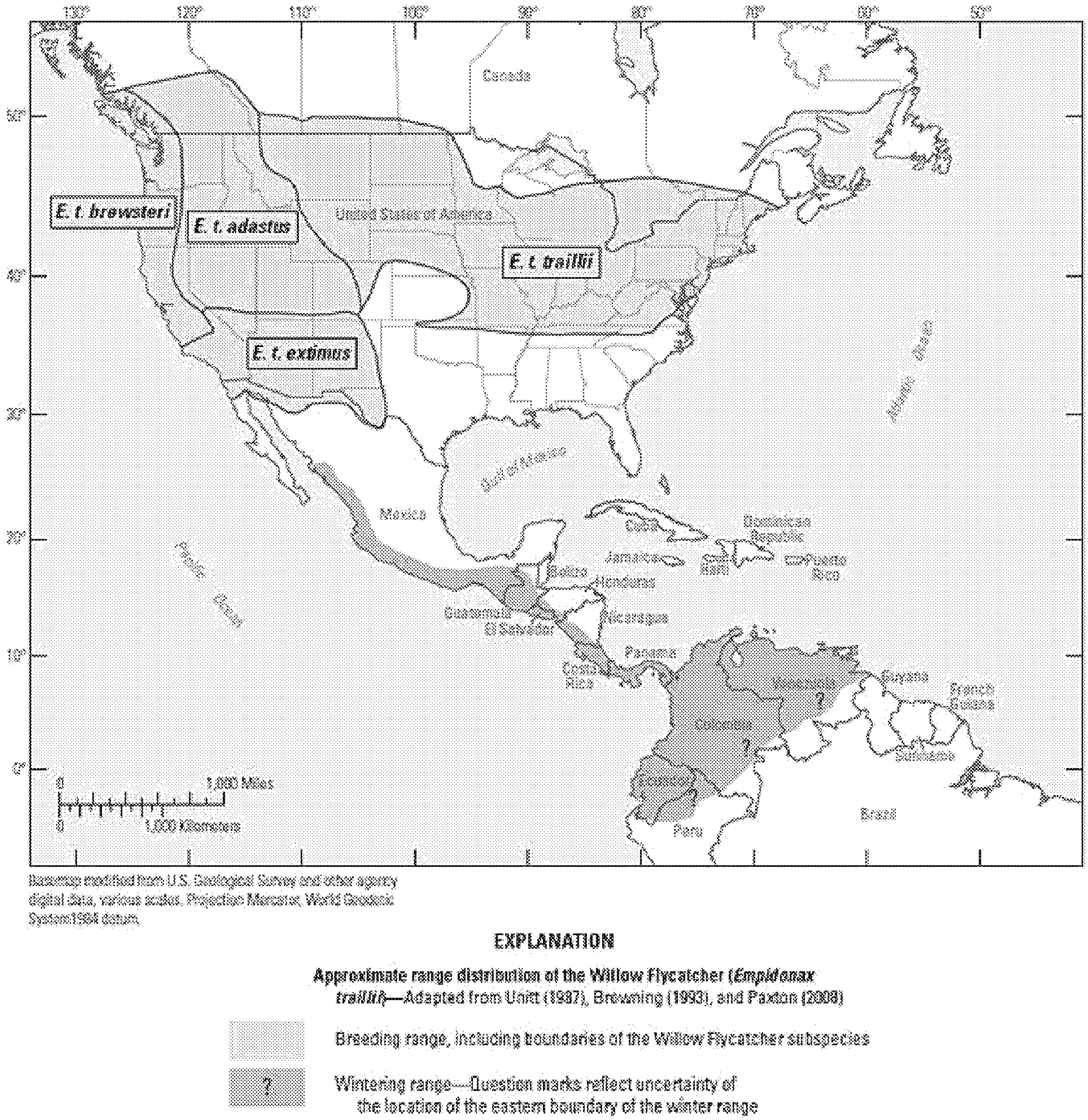

Figure 5-3 Willow Flycatcher Breeding and Wintering Ranges in North, Central, and South America (Sogge et al. 2010)

Currently 288 known southwestern willow flycatcher breeding sites in California, Nevada, Arizona, Utah, New Mexico, and Colorado hold an estimated 1,299 territories (Durst et al. 2006) (Table 5-1). Currently, range wide population stability is believed to be largely dependent on the presence of four large populations (Cliff/Gila Valley, New Mexico; Roosevelt Lake, Arizona; San Pedro/Gila River confluence, Arizona; middle Rio Grande, New Mexico) where approximately 50 percent of the 1,299 territories currently exist. None of these breeding sites are known to occur within the Action Area.

Table 5-1 Estimated Number of Southwestern Willow Flycatcher Breeding Sites and Territories by State, as of 2007

State	Number of Sites	Percentage of Total Sites	Number of Territories	Percentage of Total Territories
Arizona	124	43.1	459	35.3
California	96	33.3	172	13.2
Colorado	11	3.8	66	5.1
New Mexico	41	14.2	519	40.0
Nevada	13	4.5	76	5.9
Utah	3	1.0	7	0.5
Total	**288**		**1,299**	

In New Mexico the known breeding range of the flycatcher is considered to be from the Rio Grande Valley westward, including the Rio Grande, Chama, Zuni, San Francisco, and Gila watersheds. Small breeding populations also occur in the San Juan drainage and along Coyote Creek in the Canadian River drainage. Breeding remains unconfirmed in the Pecos drainage. The Gila Valley was identified as a stronghold for the taxon, and recent surveys have confirmed that area contains one of the largest known flycatcher populations (USFWS 2002c).

Efforts are currently underway to restore riparian habitat in the San Juan River Basin. The San Juan Watershed Woody-Invasives Initiative (SJWWII) was formed in 2006 with the objective of coordinating efforts to control and reduce salt cedar (tamarisk) and Russian olive coverage in the basin and restore communities of native plants such as willow and cottonwood. The SJWWII includes over 60 partners from four states and four tribes. Information about the SJWWII is available online at http://www.sjwwii.org. The SJWWII strategic plan provides goals for riparian restoration in the San Juan River watershed, guidelines for management of riparian zones, and a mechanism for coordination among partners (SJWWII 2006). These riparian restoration efforts indicate that suitable nesting and foraging habitat for southwestern willow flycatcher and yellow-billed cuckoo could develop along the San Juan River over the next 25 years. It is anticipated that habitat at Morgan Lake will continue to be managed as it has historically, with high recreational use. Because of this use, it is not anticipated that habitat for southwestern willow flycatcher or yellow-billed cuckoo will improve over time. Morgan Lake will continue to provide poor-quality stopover habitat in the future, but will not support nesting or suitable long-term foraging habitat for these species.

5.3.5 Critical Habitat

On July 22, 1997, critical habitat was designated for southwestern willow flycatcher (62 FR 39129; USFWS 2002c). Subsequent to the 1997 designation, critical habitat was expanded to include approximately 1,227 river miles (RM)(2,055 km), as amended in the 2013 final ruling (USFWS 2013a) (Figure 5-4).

The lateral extent of critical habitat includes areas within the 100-year floodplain of select river systems known to support this species. Critical habitat also includes riparian plant species in a successional riverine environment (for nesting, foraging, migration, dispersal, and shelter), specific structure of this vegetation, and insect populations for food. A variety of river features such as broad floodplains, water, saturated soil, hydrologic regimes, elevated groundwater, fine sediments, and others help develop and maintain components of this species critical habitat (USFWS 2013a).

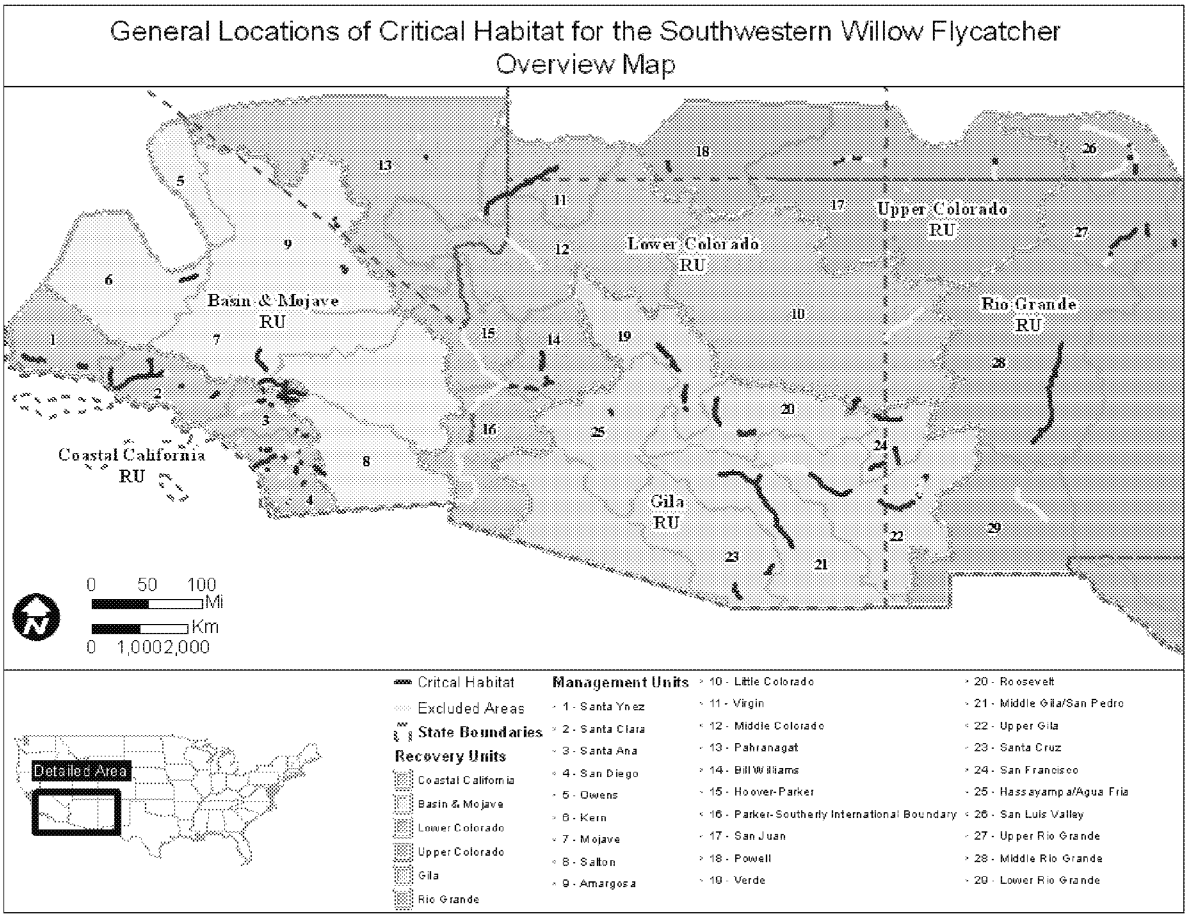

Figure 5-4 Southwestern Willow Flycatcher Range in the Southwest United States and Locations of Critical Habitats

5.3.6 <u>Identified Threats</u>

Factors affecting the decline of southwestern willow flycatcher and current threats it faces are numerous, complex, and interrelated. Overall threats to southwestern willow flycatcher can be grouped into five major factor categories: present or threatened destruction, modification, or curtailment of habitat or range; disease or predation, inadequacy of existing regulatory mechanisms, and other natural or man-made factors. Threatened destruction, modification, or curtailment of habitat or range identifies the following factors as threats: clearing and removal of riparian forest for agriculture, urban development, water diversion and impoundment, flood control, stream channelization and stabilization, livestock grazing, off-road vehicle (ORV) use, recreational uses, and unquantified threats associated with migration and winter range stresses caused by a number of human related factors including insufficient stopover habitat as a direct result of tropical deforestation within the wintering and migration corridors. Under the disease or predation category both West Nile Virus and predation are identified as contributing factors. Under the lack of regulatory mechanisms category the following factors were identified: Migratory Bird Treaty Act and State Regulatory Mechanisms. Under the other natural or man-made factors category the following factors were identified: small and widely separate habitat patches, brood parasitism, livestock grazing, pesticide use, and recreation.

5.4 Yellow-Billed Cuckoo

5.4.1 Species Description

Yellow-billed cuckoo (*Coccyzus americanus*) is a member of the avian family Cuculidae and order Cuculiformes. The approximate 128 members of Cuculidae share the common feature of a zygodactyl foot, in which two toes point forwards and two toes point backwards. Most species have moderate to heavy bills, somewhat elongated bodies, a ring of colored bare skin around the eye, and loose plumage. Six species of Cuculidae breed in the U.S.; two of these species breed west of the Continental Divide - yellow-billed cuckoo and the greater roadrunner (USFWS 2011b).

Yellow-billed cuckoo is a medium-sized bird of about 12 inches (30 cm) in length, and weighing about 2 ounces (57 grams [g]). The species has a slender, long-tailed profile, with a fairly stout and slightly down-curved bill, which is blue-black with yellow on the basal half of the lower mandible. Plumage is grayish-brown above and white below, with rufous primary flight feathers. The tail feathers are boldly patterned with large white spots on a black background on the underside of the tail. The legs are short and bluish-gray, and adults have a narrow, yellow eye ring. Juveniles resemble adults, except the tail patterning is less distinct, and the lower bill may have little or no yellow. Males and females differ slightly. Males tend to have a slightly larger bill and the white in the tail tends to form oval spots, whereas in females the white spots tend to be connected and less distinct (USFWS 2011b).

5.4.2 Life History

Western cuckoos breed in large blocks of riparian habitats, particularly woodlands with cottonwoods (*Populus fremontii*) and willows (*Salix* spp.). Dense understory foliage appears to be an important factor in nest site selection, while cottonwood trees are an important foraging habitat in areas where the species has been studied in California. In the Lower Colorado River this species occupies riparian areas that have higher canopies, denser cover in the upper layers of the canopy, and sparser shrub layers when compared to unoccupied sites. Although this species is generally associated with breeding and nesting in large wooded riparian areas dominated by cottonwood trees, they have been documented nesting in salt cedar between Albuquerque and Elephant Butte Reservoir and along the Pecos River in southeastern New Mexico. At the landscape level, the amount of cottonwood-willow-dominated vegetation cover in the landscape and the width of riparian habitat appeared to influence cuckoo distribution and abundance.

Nesting sites are generally selected in locations near water. Clutch size is usually two or three eggs, and development of the young is very rapid, with a breeding cycle of 17 days from egg-laying to fledging of young. Although yellow-billed cuckoos usually raise their own young, they are facultative brood parasites, occasionally laying eggs in the nests of other yellow-billed cuckoos or of other bird species (USFWS 2011b).

Diet of this species consists of caterpillars, lepidopterans, and often supplemented with beetles, ants, and spiders. They also take advantage of the annual outbreaks of cicadas, katydids, and crickets, and will forage for small frogs and lizards. In summer and fall, cuckoos forage on small wild fruits, including elderberries, blackberries, and wild grapes. In winter, fruit and seeds become a larger part of the diet.

5.4.3 Population Dynamics

Since 1980, statewide surveys from New Mexico, Arizona, and California indicate an overall estimated 52 percent decline with numbers too low to establish trends from Idaho, Montana, Utah, Nevada, and Colorado. Trend information is also lacking from west Texas and Mexico. Yellow-billed cuckoo has been extirpated as a breeding bird in Washington, Oregon, and British Columbia (USFWS 2011b). Comparisons of historic and current information suggest that the western yellow-billed cuckoo's range and population numbers have declined substantially across much of the western U.S. over the past 50 years. Analysis of population trends is difficult because quantitative data, including historic population estimates, are generally lacking. However, rough extrapolations based on both observed densities of yellow-billed cuckoos and historic habitat distribution indicate that western populations were once substantial (Johnson et al. 2007).

Although the overall population size of this species remains large, western populations in many areas have decreased dramatically. Major declines among western populations in the 20th century are attributed to habitat loss and fragmentation. Although once considered a common nester in Arizona river bottoms, fewer than 50 pairs were estimated present in the state in the early 1990s. The greatest declines have been in California, from an estimated 15,000 pairs in the late 19th century to a few dozen pairs by the mid-1980s (New Mexico Partners in Flight 2014).

5.4.4 Status and Distribution

Yellow-billed cuckoo in the western U.S. was accorded candidate status in July 2001. On October 3, 2013, the Western U.S. Distinct Population Segment (DPS) of yellow-billed cuckoo was proposed as a threatened species under the ESA (USFWS 2013b). This designation applies to the western DPS that occurs in the following states: Washington, Oregon, California, Idaho, Nevada, Montana, Wyoming, Utah, Arizona, Colorado, New Mexico, and Texas (USFWS 2011b). The area for the western DPS of yellow-billed cuckoo is west of the crest of the Rocky Mountains (Figure 5-5). For the northern tier of Rocky Mountain states (Montana, Wyoming, northern and central Colorado), the crest coincides with the Continental Divide. In the southern tier of Colorado and New Mexico, the crest coincides with the eastern boundary of the upper Rio Grande drainage, including the Sangre de Cristo Mountains and excluding the drainage of the Pecos River. In west Texas, the DPS boundary is the line of mountain ranges that form a southeastern extension of the Rocky Mountains to the Big Bend area of west Texas, and that form the western boundary of the Pecos River drainage (USFWS 2011b)

Based on historic accounts, the species was widespread and locally common in California and Arizona, locally common in a few river reaches in New Mexico, locally common in Oregon and Washington, generally local and uncommon in scattered drainages of the arid and semiarid portions of western Colorado, western Wyoming, Idaho, Nevada, and Utah, and probably uncommon and local in British Columbia (USFWS 2011b).

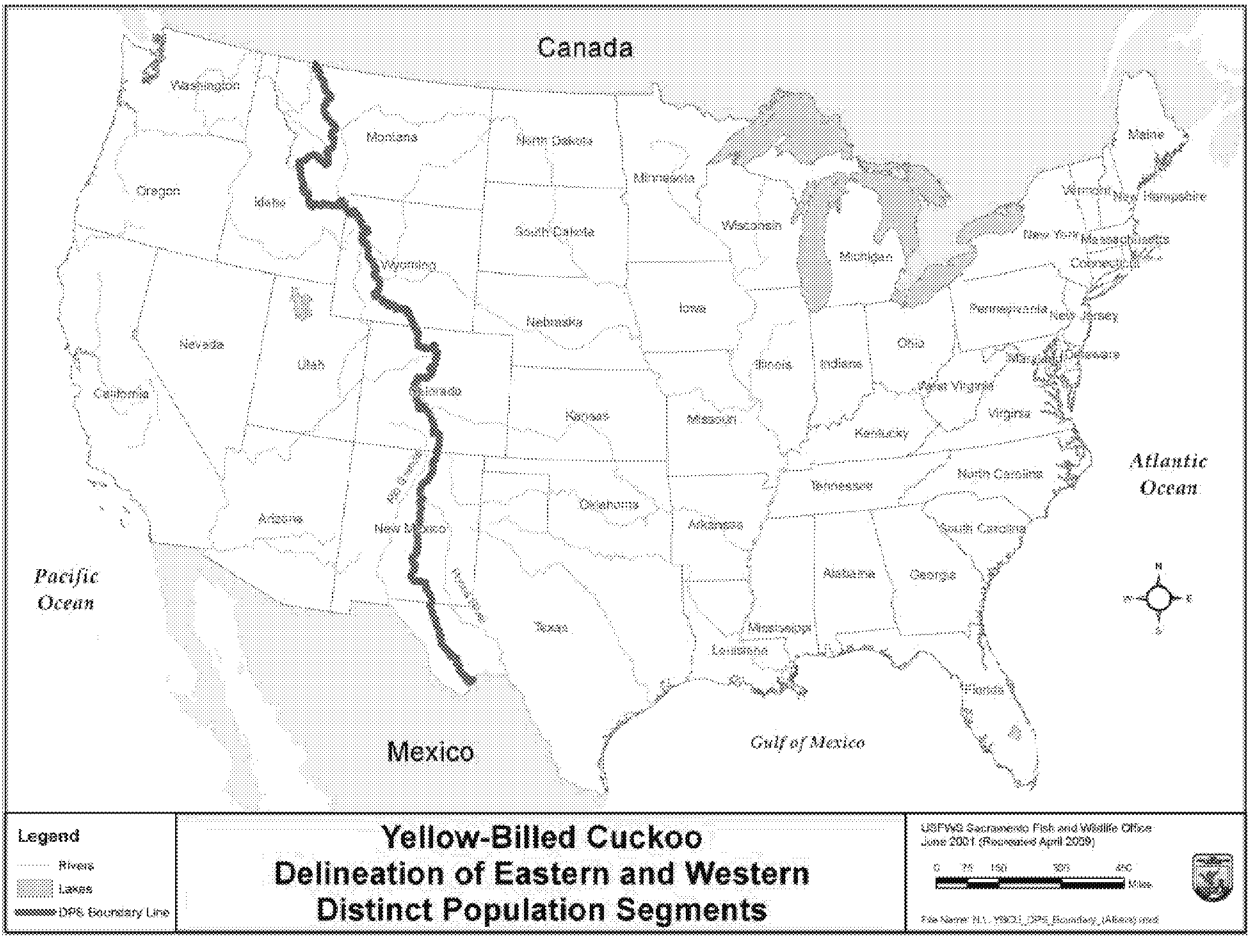

Figure 5-5 Yellow-Billed Cuckoo Eastern and Western DPS Boundary (USFWS 2011b)

In New Mexico, the species was historically rare statewide, but common in riparian areas along the Pecos River and Rio Grande, as well as uncommon to common locally along portions of the Gila, San Francisco, and San Juan rivers. In New Mexico, the species is found in riparian zones with dense understory vegetation, most commonly in the south and along major drainages. The species was fairly common in the mid-1980s along the Rio Grande between Albuquerque and Elephant Butte Reservoir and along the Pecos River in southeastern New Mexico. Numbers may have increased there in response to salt cedar colonization of riparian areas formerly devoid of riparian vegetation. A review on the status of the species in New Mexico concluded that the species would likely decline in the future due to loss of riparian woodlands. In the eastern third of the state, non-native salt cedar has provided habitat for approximately 1,000 pairs of yellow-billed cuckoos in historically unforested areas (USFWS 2011b).

As described for southwestern willow flycatcher, the SJWWII is working to restore riparian habitat in the San Juan watershed. The SJWWII strategic plan provides goals for riparian restoration in the San Juan River watershed, guidelines for management of riparian zones, and a mechanism for coordination among partners (SJWWII 2006). These riparian restoration efforts indicate that suitable nesting and foraging habitat for southwestern willow flycatcher and yellow-billed cuckoo could develop along the San Juan River over the next 25 years. It is anticipated that habitat at Morgan Lake will continue to be managed as it has historically, with high recreation use. Because of this use, it is not anticipated that habitat for southwestern willow flycatcher or yellow-billed cuckoo will improve over time. Morgan Lake will continue to provide poor-quality stopover habitat in the future, but will not support nesting or suitable long-term foraging habitat for these species.

5.4.5 Critical Habitat

No critical habitat has been designated for the western yellow-billed cuckoo (USFWS 2011b, 2013b).

5.4.6 Threats

Overall threats and factors affecting yellow-billed cuckoo can be grouped into five major categories (USFWS 2013b): present or threatened destruction, modification, or curtailment of habitat or range; overutilization for commercial, recreational, scientific, or educational purposes; disease or predation, inadequacy of existing regulatory mechanisms, and other natural or man-made factors. Threatened destruction, modification, or curtailment of habitat or range identifies the following factors as threats: clearing and removal of riparian forest for agriculture, urban development, water diversion and impoundment, flood control, stream channelization and stabilization, livestock grazing, ORV use, recreational uses, and unquantified threats associated with migration and winter range stresses caused by a number of human related factors including insufficient stopover habitat as a direct result of tropical deforestation within the wintering and migration corridors. Under the overutilization category the following threats have been identified: commercial exploitation, recreational exploitation, scientific exploitation, and educational exploitation. Under the disease or predation category both West Nile Virus and predation are identified as contributing factors. Under the lack of regulatory mechanisms category the following factors were identified: Migratory Bird Treaty Act, Federal Land Policy and Management Act, Federal Water Pollution Act of the Clean Water Act. National Environmental Policy Act, Federal Power Act, State Regulatory Mechanisms, and Canadian, Mexican, and other International Laws. Under the other natural or man-made factors category the following factors were identified: small and widely separate habitat patches and pesticide use.

5.5 California Condor

5.5.1 Species Description

California condor (*Gymnogyps californianus*) is a member of the family Cathartidae or New World vultures. California condors are among the largest flying birds in the world. Adults weigh approximately 22 pounds (10 kg) and have a wingspan up to 9.5 feet (2.9 meters). Adults are black except for prominent white underwing linings and edges of the upper secondary coverts. The head and neck are mostly naked, and the bare skin is gray, grading into various shades of yellow, red, and orange. Males and females cannot be distinguished by size or plumage characteristics. The heads of juveniles up to 3 years old are grayish-black, and their wing linings are variously mottled or completely dark. During the third year the head develops yellow coloration, and the wing linings become gradually whiter. By the time individuals are 5 or 6 years of age, they are essentially indistinguishable from adults, but full development of the adult wing patterns may not be completed until 7 or 8 years of age (USFWS 2013c).

5.5.2 Life History

California condors nest in various types of rock formations including crevices, overhung ledges, and potholes and, more rarely, in cavities in giant sequoia trees (*Sequoia giganteus*). Although potential condor nesting habitat still exists over a relatively large portion of the coastal and interior mountains in central and southern California, the recently occupied nesting range was quite limited (USFWS 2013c).

Courtship and nest site selection by breeding California condors occurs from December through the spring months. Reproductively mature, paired California condors normally lay a single egg between late January and early April. The egg is incubated by both parents and hatches after approximately 56 days. Both parents share responsibilities for feeding the nestling. At 2 to 3 months of age condor chicks leave the actual nest cavity, but remain in the vicinity of the nest where they are fed by their parents. The chick takes its first flight at about 6 to 7 months of age, but may not become fully independent of its parents until the following year (USFWS 2013c).

California condors are opportunistic scavengers, feeding only on the carcasses of dead animals, including deer, cattle, and marine mammals such as whales and seals. A condor may eat up to 3 to 4 pounds at a time and may not need to feed again for several days. After eating, condors bathe in rock pools and will spend many hours preening and drying their feathers. Typical foraging behavior includes long-distance reconnaissance flights, lengthy circling flights over a carcass, and hours of waiting at a roost or on the ground near a carcass. Seasonal foraging behavior shifts perhaps are the result of climatic cycles or changes in food availability. Having located a potential food item, California condors frequently remain in the air circling high above the carcass before landing. Most California condor foraging occurs in open terrain on foothill grassland and oak savannah habitats, as this species typically requires open spaces for feeding to ensure easy take-off and approach to facilitate feeding and escape (USFWS 2013c).

5.5.3 Population Dynamics

Condor censusing efforts through the years varied in intensity and accuracy, which has led to conflicting estimates of historical abundance. However, they have indicated an ever-declining California condor population. An estimated population of about 60 individuals was documented in the late 1930s through the mid-1940s, apparently based on observed flock size. A field study by Eben and Ian McMillan in the early 1960s suggested a population of about 40 individuals, again based in part on the validity of previous estimates of flock size. An annual October California condor survey was begun in 1965 and continued for 16 years. The results supported an estimate of 50 to 60 extant California condors in the late 1960s. Survey efforts continued into the 1970s and concurred with the interpretations of the earlier surveys data, estimating that by 1978 the population had dropped to 25 to 30 individuals (Kiff et al. 1996).

In 1985, the condor population was reassessed using the 1953 and 1965 population estimates and concluded that the population was underestimated by a factor of 2 or 3. In 1981, USFWS, in cooperation with California Polytechnic State University at San Luis Obispo, began census efforts identifying a steady decline from an estimated minimum of 21 wild condors in 1982, 19 individuals in 1983, 15 individuals in 1984, and 9 individuals in 1985. By the end of 1986, all but 2 California condors were captured for safekeeping and genetic security. On April 19, 1987, the last wild condor was captured and taken into captivity. The population has increased annually since 1988. Since December 1996, program personnel have soft-released approximately 6 to 10 birds into the wild per year (Kiff et al. 1996).

Population growth has been steady over the last 2 decades, and in late 2008 the wild California condor population exceeded the captive population for the first time since 1983. As of December 31, 2012, the total California condor population was 404 individuals: 235 in the wild and 169 in captivity (USFWS 2013c).

5.5.4 Status and Distribution

California condor was included on the List of Endangered Species issued by the Office of Endangered Species in 1967 (32 FR 4001, 1967 March 11) prior to the passage of the ESA, followed by protection of Critical Habitats in 1976 (41 FR 41914, 1976 September 24), except where Nonessential Experimental populations occur in portions of northern Arizona, Nevada, and Utah. (61 FR 54043 54060, 1996 October 16). This species is presently listed on the NESL as a G4 species. In an effort to identify the USFWS future management objectives and to prevent further decline in the California condor population, the California Condor Recovery Plan was completed in 1975, followed by revisions in 1979, 1984, and most recently, 1996.

The California Condor Recovery Plan describes the reasons for endangerment and status of California condor, addresses important recovery actions, includes detailed issue papers on management issues, and provides recovery goals. Recovery is based on continued captive breeding and release goals for the species entire population throughout the species entire range and establishing long-term conservation plans

(Kiff et al. 1996). USFWS published a 5-year review summary and evaluation of California condor in June 2013 detailing known distribution and population data available to date (USFWS 2013c).

Current condor distribution is limited to three major reintroduction sites, including reserves in California located in Ventura, Santa Barbara, Kern, Monterey, and San Luis Obispo counties. In northern Arizona, California condors are located primarily near the Vermilion Cliffs and Grand Canyon (Figure 5-6). This population in northern Arizona is a "nonessential experimental." Another reintroduction area in a remote area of Baja California, Mexico, was added in 2002 (Arizona Game and Fish Department 2014). A summary of the present day California condor population is detailed below in Table 5-2. No known nesting locations are documented to occur within the mine area or Deposition Area. The species is undocumented in this area of New Mexico.

There is a small potential that the species could be an occasional visitor to portions of the Action Area, particularly the FCPP to Moenkopi ROW, however. Telemetry and GPS records reveal condors currently exceed the boundaries of the occupied habitat that was known and defined at the time of the initial field reviews conducted by the USFWS in the late 1960s, and take advantage of food opportunities at increasingly farther distances from release or other management sites. Typical foraging behavior includes long-distance reconnaissance flights, lengthy circling over a carcass, and hours of waiting at a perch or on the ground near a carcass, possibly watching for predators. Paired birds tend to forage most frequently in areas relatively close to their nests, not normally venturing more than 31 to 44 miles from their nest sites; although on occasion members of a nesting pair will travel over 100 miles. During the non-breeding season paired birds tended to expand their home range to encompass more of the available foraging areas ranging up to 100 miles with individuals ranging up to 400 miles from nesting and release areas (Kiff et al 1996; USFWS 2013c).

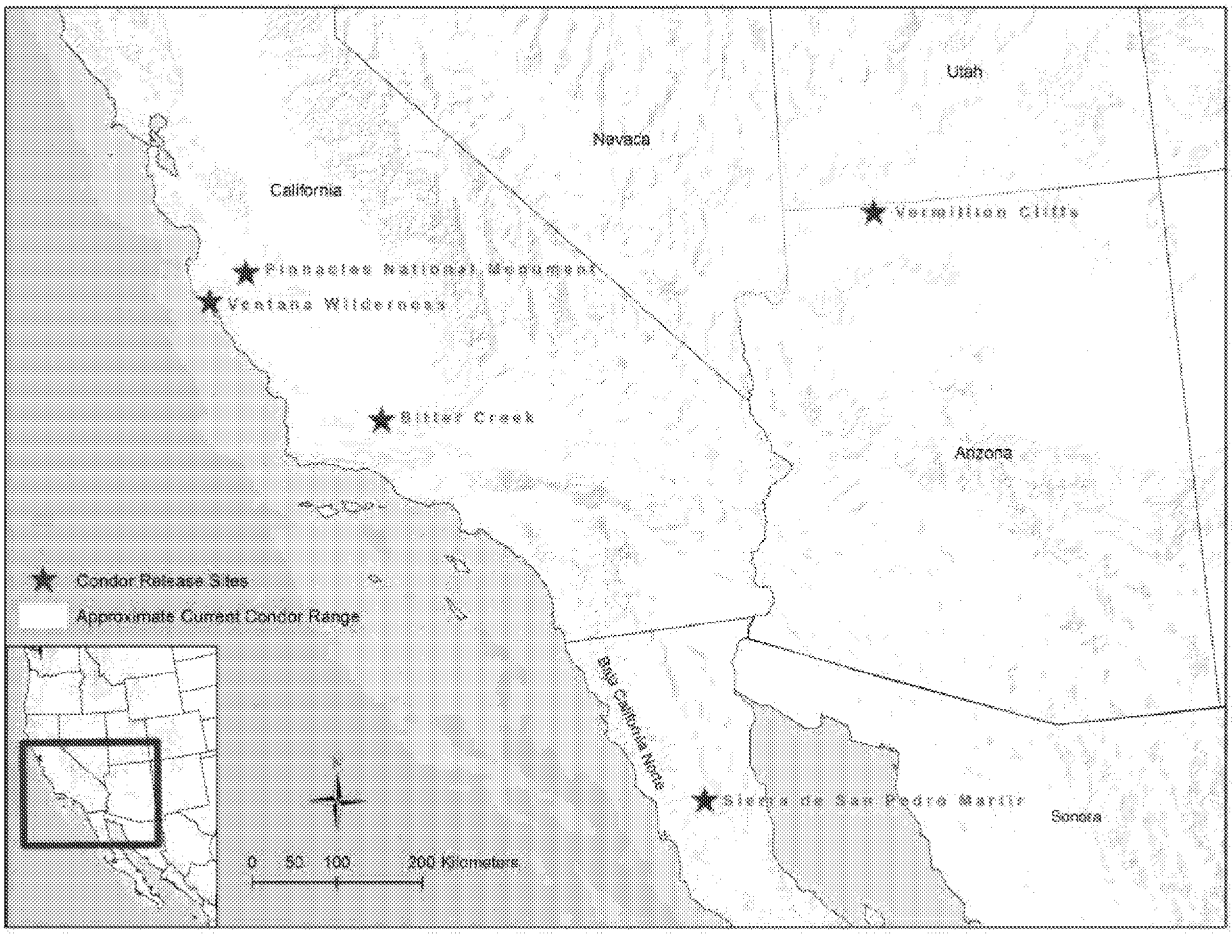

Figure 5-6 Current Range of California Condor and Active Release Sites

Table 5-2 2012 USFWS California Condor Captive and Wild Population Census

Condor Population	
Captive Population	169
Arizona Population (wild)	78
California Population (wild)	129
Baja Population (wild)	28
Total Wild Population	235
Total Population	**404**

5.5.5 Critical Habitat

USFWS established Critical Habitat for California condor in 1976, including approximately 570,000 acres of Critical Habitat in six counties in southern California. No critical habitat occurs within Arizona or New Mexico.

5.5.6 Threats

Causes of California condor population decline have probably been numerous and variable through time. However, despite decades of research, it is not known with certainty which mortality factors have been dominant in the overall decline of the species. Relatively few dead condors have been found, and definitive conclusions on the causes of death were made in only a small portion of these cases. Poisoning, shooting, egg and specimen collecting, collisions with man-made structures, and loss of habitat have contributed to the decline of the species.

Threats to California condor also include loss and modification of condor foraging, roosting, and nesting habitats. They include human encroachment by permanent development or temporary displacement of condors from suitable breeding and nesting sites. Similarly continued development of native habitats for agricultural conversion and rangeland conversion to urban development, oil and gas extraction, farming, and wind energy development have transformed formerly suitable foraging habitat into areas that may not be compatible with condor recovery.

During the first several years of releases, 4 California condor deaths occurred (31 percent of released birds in the first 2 years) from blunt trauma from hitting power lines or from electrocution from perching on power lines or poles. Pre-release powerline aversion training of captive-reared birds began in 1995. The powerline aversion technique has proven successful in reducing a propensity for condors to associate with power poles. Seven additional deaths in the free-flying population occurred through 2007, or 4 percent of released birds since the aversion training began. In many but not all cases, death occurred in close proximity to release sites and involved young birds. Some remediation of potential problem areas was conducted and no powerline-associated deaths, from either trauma or electrocution, have occurred since 2007 (USFWS 2013c). Power lines have had significant impacts on the population in the past, but aversion training has been successful in developing avoidance behaviors. Despite these efforts the potential for electrocution or blunt trauma following collisions with power lines remains a threat (USFWS 2013c).

5.6 Mexican Spotted Owl

5.6.1 Species Description

Mexican spotted owl (*Strix occidentalis lucida*) is one of three subspecies of spotted owl recognized by the American Ornithologists' Union in the last checklist to include subspecies designations. The other two subspecies are the northern (*S. o. caurina*) and California (*S. o occidentalis*) spotted owls. The Mexican subspecies is geographically isolated from both the California and northern subspecies. Studies suggest that Mexican spotted owl is genetically isolated from the other subspecies (USFWS 2012b).

Mexican spotted owl is a medium-sized owl without ear tufts and mottled with irregular white spots on its brown abdomen, back, and head. Mexican spotted owl differs from the two other subspecies of spotted owls in plumage coloration; the white spots of Mexican spotted owl are generally larger and more numerous than in the other two subspecies, giving it a lighter appearance. Wing and tail feathers are dark brown barred with lighter brown and white and, unlike most owls in North America, spotted owls have dark eyes (USFWS 2012b, 2014).

Adult male and female Mexican spotted owls are similar in plumage; however, females are larger, on average, than males. Juveniles, subadults, and adults can be distinguished by plumage characteristics. Juvenile owls (hatchling to approximately 5 months) have a downy appearance. Subadult owls (5 to approximately 26 months) closely resemble adults, but they have pointed tail feathers with a pure white terminal band. The tail feathers of adults (>27 months) have rounded tips, and the terminal band is mottled brown and white (USFWS 2012b).

5.6.2 Life History

Spotted owls are residents of old-growth or mature forests that possess complex structural components (uneven aged stands, high canopy closure, multi-storied levels, high tree density). Canyons with riparian or conifer communities are also important components. In southern Arizona and New Mexico, the mixed conifer, Madrean pine-oak, Arizona cypress, encinal oak woodlands, and associated riparian forests provide habitat in the small mountain ranges distributed across the landscape. Owls are also found in canyon habitat dominated by vertical-walled rocky cliffs within complex watersheds, including tributary side canyons. Rock walls with caves, ledges, and other areas provide protected nest and roost sites. Canyon habitat may include small isolated patches or stringers of forested vegetation including stands of mixed-conifer, ponderosa pine, pine-oak, pinyon-juniper, and/or riparian vegetation in which owls regularly roost and forage. Owls are usually found in areas with some type of water source (i.e., perennial stream, creeks, and springs, ephemeral water, small pools from runoff, reservoir emissions). Even small sources of water such as small pools or puddles create humid conditions. (USFWS 2012b)

The owl occupies a broad geographical area, but does not occur uniformly throughout its range. Instead, the owl occurs in disjunct localities that correspond to isolated mountain systems and canyons. The owl is frequently associated with mature mixed-conifer (Douglas-fir [*Pseudotsuga menziesii*], white fir [*Abies concolor*], limber pine [*Pinus flexilis*] or blue spruce [*Picea pungens*]), pine-oak (ponderosa pine [*Pinus ponderosa*]) and Gambel oak [*Quercus gambellii*]), and riparian forests. Typically found between 4,100 and 9,000 feet of elevation (USFWS 2012b).

Mated pairs are territorial. The breeding season activity centers tend to be smaller than the non-breeding season activity centers, with considerable overlap between the two. Adults may or may not leave the territory during the winter. Most adults remain on the same territory year after year. Juveniles leave their natal territory in September, and while they are capable of moving long distances, many successfully establish themselves nearby and in the process travel through a variety of vegetation communities (USFWS 2012b).

Roosting and nesting habitats exhibit certain identifiable features, including large trees (those with a trunk diameter of 12 inches or more, uneven aged tree stands, multi-storied canopy, a tree canopy creating shade over 40 percent or more of the ground, and decadence in the form of downed logs and standing dead trees. Canopy closure is typically greater than 40 percent (USFWS 2012b).

Owl foraging habitat includes a wide variety of forest conditions, canyon bottoms, cliff faces, tops of canyon rims, and riparian areas. Juvenile owls disperse into a variety of habitats ranging from high-elevation forests to pinyon-juniper woodlands and riparian areas surrounded by desert grasslands. Observations of long-distance dispersal by juveniles provide evidence that they use widely spaced islands of suitable habitat, which are connected at lower elevations by pinyon-juniper and riparian forests (USFWS 2012b).

Owls feed on small mammals, particularly mice, voles, and wood rats. They will also take birds, bats, reptiles, and arthropods. Mexican spotted owl is a "perch and pounce" predator, using elevated perches to find prey items using sight and sound. They can take prey on the wing, particularly birds. Most hunting is at night; however, some reports of diurnal foraging exist (USFWS 2012b).

5.6.3 Population Dynamics

Mexican spotted owl population trends remain unclear. However, Mexican spotted owl population size for a specific area and time is modeled using the combined effects of births, deaths, immigration, and emigration, which influence the viability of the population and its long-term persistence over a period of at least 10 years. Data on trends in populations or occupancy rates are few, and methods and sample sizes differ among studies, making comparisons difficult. However, results from these study areas have all noted that the study populations have declined in the recent past (USFWS 2013d). Further, range-wide conclusions cannot be reliably inferred from the limited data available.

5.6.4 Status and Distribution

In 1993 the USFWS listed Mexican spotted owl as threatened under the ESA. Critical habitat for Mexican spotted owl was designated in 2004, comprising approximately 3.5 million hectares (8.6 million acres) on federal lands in Arizona, Colorado, New Mexico, and Utah (69 FR 53182). Within the critical habitat boundaries, critical habitat includes protected and restricted habitats as defined in the original Mexican Spotted Owl Recovery Plan, completed in 1995.

The Recovery Plan for Mexican spotted owl was completed by USFWS Region 2 (Southwest Region) in December 1995. Since that time, USFWS has acquired new information on the biology, status, distribution, and other aspects of Mexican spotted owl's life history, and revised the 1995 Recovery Plan. The Revised September 2012 Recovery Plan for the Mexican Spotted Owl, First Revision, revises the 1995 Recovery Plan, incorporating new information on the owl's biology, threats, and recovery needs, and outlines a comprehensive program for its recovery. Directly following the September 2012, USFWS released the Mexican Spotted Owl 5-year Review (USFWS 2013d).

The current distribution of Mexican spotted owls generally follows its historical extent, with a few exceptions. For one, early records exist of spotted owls in lowland riparian areas along major rivers, such as the San Pedro in Arizona and the Rio Grande in New Mexico, but the species has not been documented in these areas since the early 1900s. In addition, previously occupied riparian communities in the southwestern U.S. and southern Mexico have undergone significant habitat alteration since the historical sightings.

Presently, Mexican spotted owl occurs in forested mountains and canyonlands throughout the southwestern U.S. and Mexico (Figure 5-7). It ranges from Utah, Colorado, Arizona, New Mexico, and the western portions of Texas south into several states of Mexico. Mexican spotted owl occupies a broad geographic area; however, it does not occur uniformly throughout its range. Instead, the owl occurs in disjunct areas that correspond with isolated mountain ranges and canyon systems. In the U.S., the majority of owls (91 percent) are found on National Forest System lands; however, in some areas of Colorado, owls are found only in rocky-canyon habitats, which primarily occur on NPS- and BLM-administered lands. Most owls have been found within the 11 National Forests of Arizona and New Mexico. It is unknown why Colorado and Utah support fewer owls (USFWS 2012b).

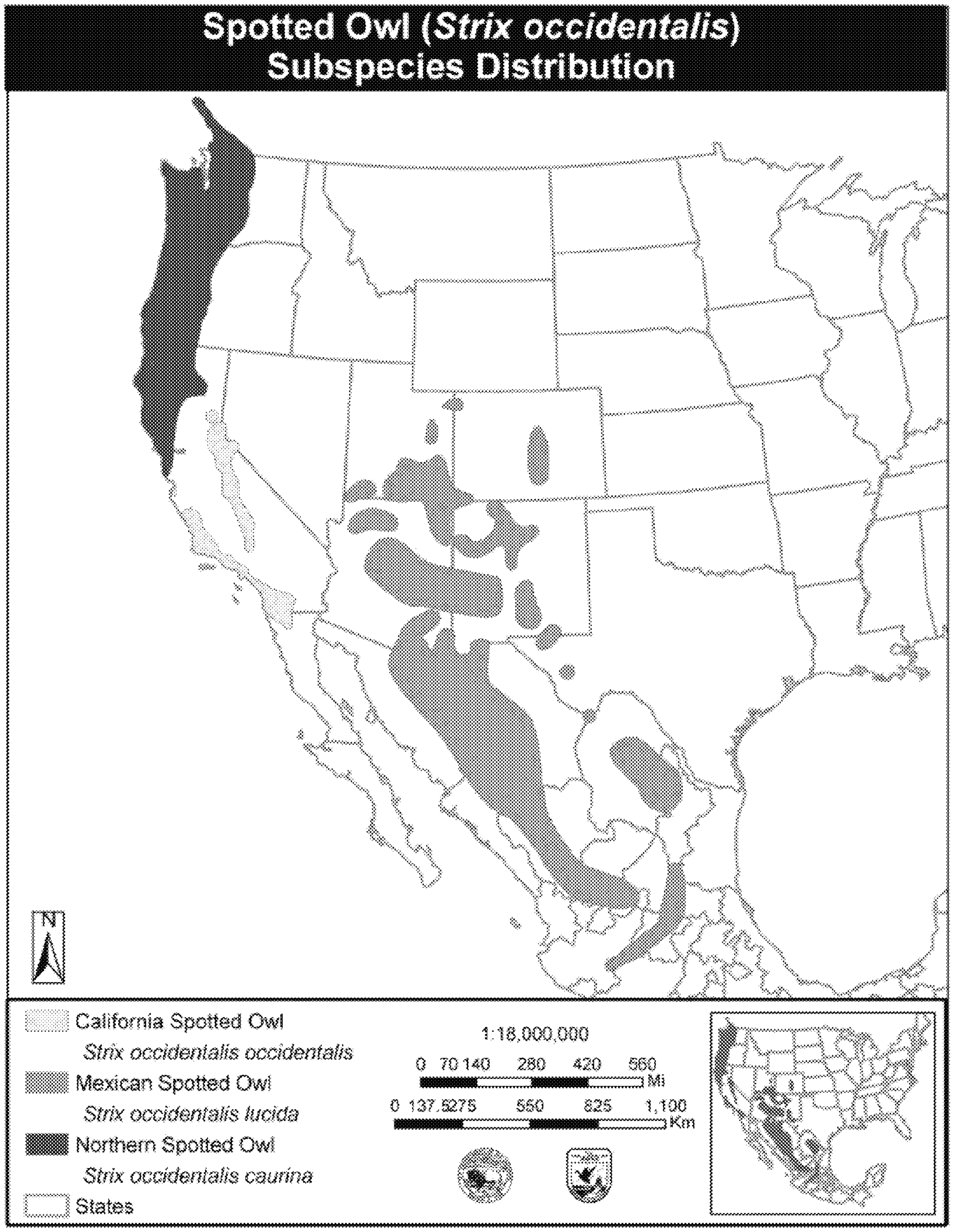

Figure 5-7 Current Range of Spotted Owl and Subspecies Distribution (USFWS 2012b)

The combination of natural variability, human influences on owls, international boundaries, and logistics of implementing the Recovery Plan necessitated subdivision of the owl range into smaller management areas. USFWS divides the owl range within the U.S. into five ecological management units: Colorado Plateau, Southern Rocky Mountains, Upper Gila Mountains, Basin and Range-West, and Basin and Range-East (Figure 5-8).

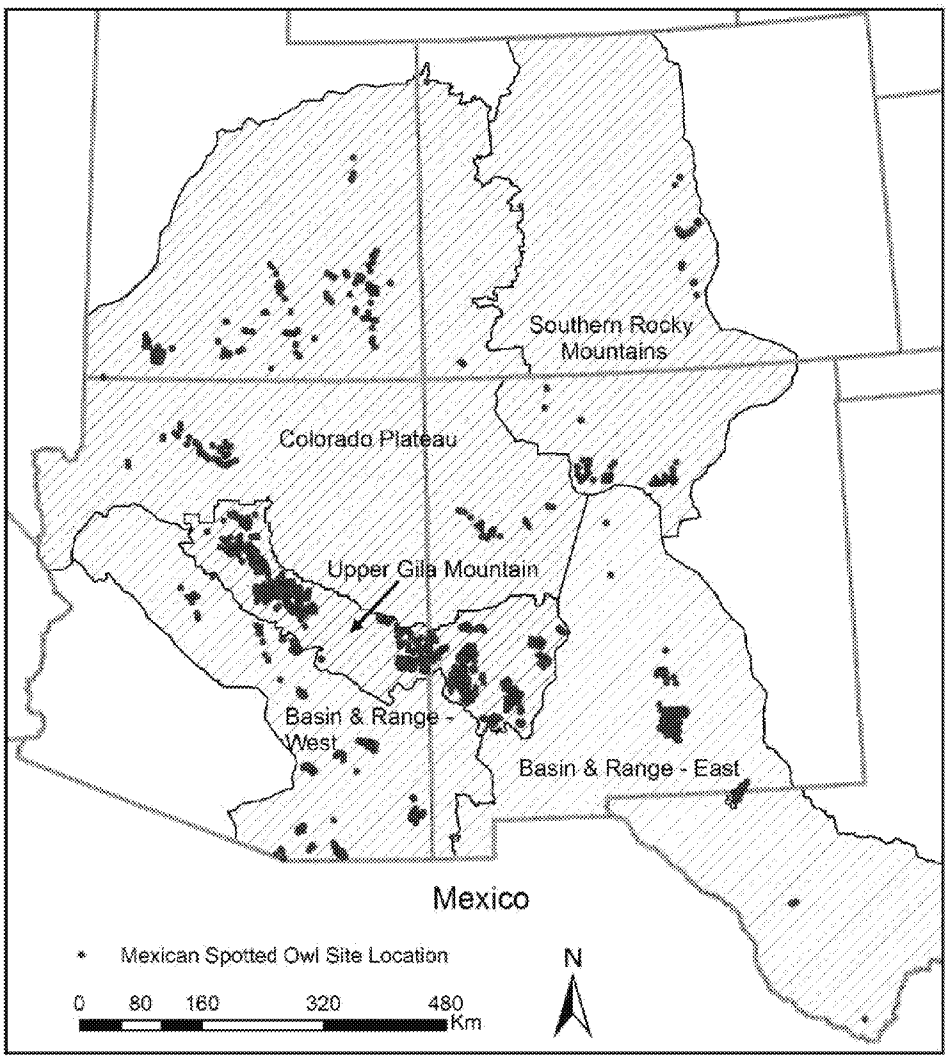

Figure 5-8 Location of Mexican Spotted Owl Ecological Management Units and Site Locations (USFWS 2012b)

5.6.5 Critical Habitat

USFWS designated critical habitat for Mexican spotted owl in 2004, on approximately 8.6 million acres of federal lands in Arizona, Colorado, New Mexico, and Utah (Figure 5-9). Within the designated boundaries, critical habitat includes only those areas defined as protected habitats: unoccupied slopes >40 percent in the mixed conifer and pine-oak forest types that have not had timber harvest in the last 20 years, steep-walled canyon areas, and restricted habitats composed of owl foraging, dispersal, and future nest/roost habitat as defined in the 1995 Recovery Plan. The PCEs for Mexican spotted owl critical habitat were determined from studies of their habitat requirements and information provided in the 1995 Recovery Plan. Since owl habitat can include both canyon and forested areas, PCEs were identified in both areas.

The PCEs identified for the owl within mixed-conifer, pine-oak, and riparian forest types that provide for one or more of the owl's habitat needs for nesting, roosting, foraging, and dispersing are a range of tree species, including mixed conifer, pine-oak, and riparian forest types, composed of different tree sizes reflecting different ages of trees; a shade canopy created by the tree branches covering 40 percent or more of the ground; and large dead trees (snags); high volumes of fallen trees and other woody debris; a wide range of tree and plant species, including hardwoods; and, adequate levels of residual plant cover to maintain fruits and seeds and allow plant regeneration.

PCE's considered for canyon habitats include steep-walled rocky canyonlands and generally occur within the Colorado Plateau Ecological Management Unit, although canyon habitat is also encountered in other units. Owls use canyon habitat for nesting, roosting, and foraging, and includes landscapes dominated by vertical-walled rocky cliffs within complex watersheds, including many tributary side canyons. These areas typically include parallel-walled canyons up to 1.2 miles in width, with canyon reaches often 1.2 miles or greater, and with cool north-facing aspects. The PCEs related to canyon habitat include one or more of the following: presence of water, clumps or stringers of mixed-conifer, pine-oak, pinyon-juniper, and/or riparian vegetation; canyon walls containing crevices, ledges, or caves; and a high percent of ground litter and woody debris (USFWS 2013d).

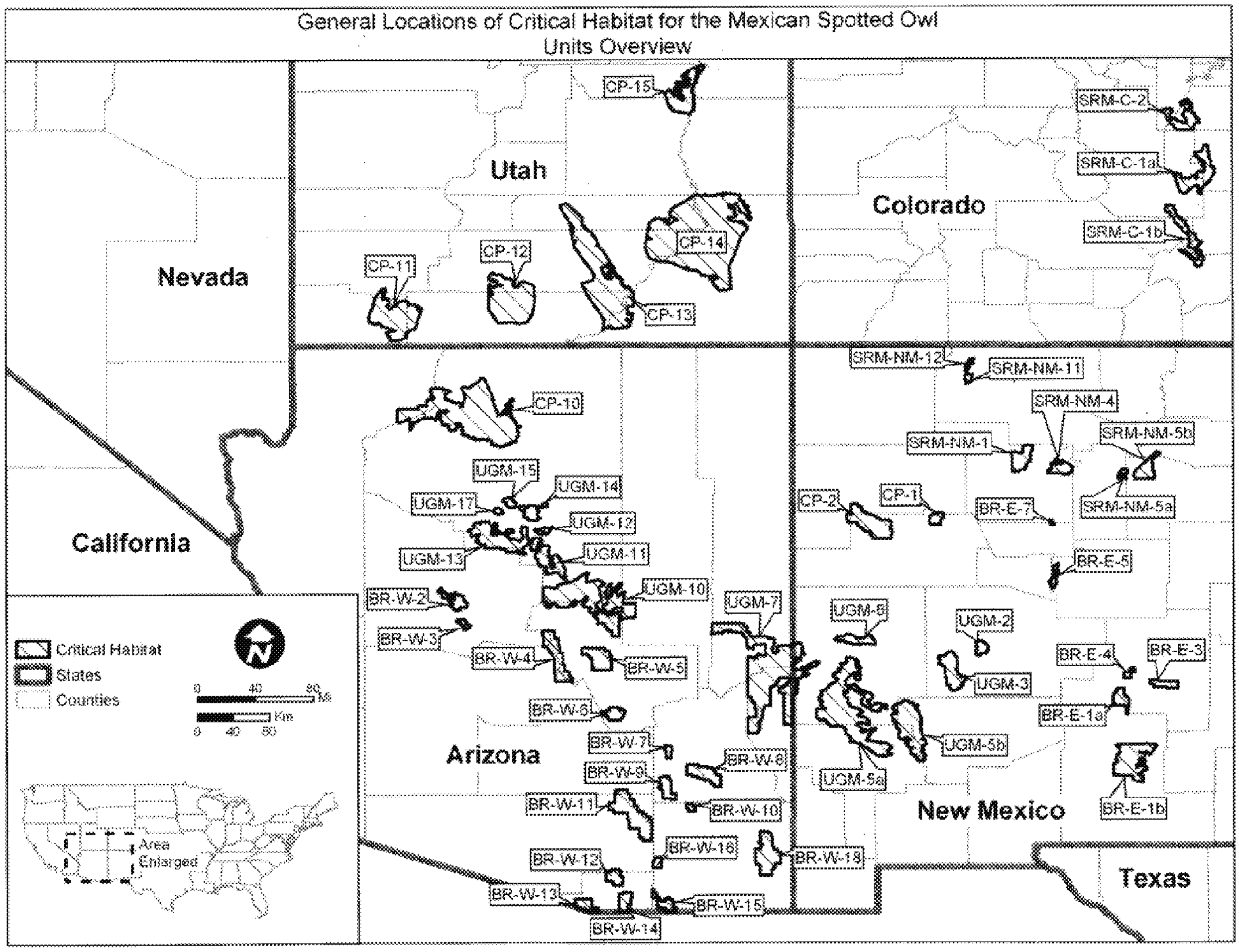

Figure 5-9 Distribution of Mexican Spotted Owl Critical Habitat and Subspecies Distribution (USFWS 2012b)

5.6.6 Threats

Overall threats factors affecting Mexican spotted owl can be grouped into five major categories: present or threatened destruction, modification, or curtailment of habitat or range; overutilization for commercial, recreational, scientific, or educational purposes; disease or predation; inadequacy of existing regulatory mechanisms, and other natural or man-made factors. Threatened destruction, modification, or curtailment of habitat or range identifies the following factors as threats: stand-replacing fire, fire suppression; burned area response; Wildland Urban Interface treatments, silvicultural treatments, insects and disease, grazing, energy development, roads and trails, land development, recreation, and water development. Under the overutilization category the following threats have been identified: commercial exploitation, recreational exploitation, scientific exploitation, and educational exploitation. Under the disease or predation category both West Nile Virus and predation are identified as contributing factors. Under the lack of regulatory mechanisms category the following factors were identified: U.S. National Fire Plan and Policy, Healthy Forest Initiative, Healthy Forest Restoration Act of 2003, Omnibus Public Land Management Act of 2009, and the Stewardship Contracting Authority. Under the other natural or man-made factors category the following factors were identified: noise and disturbance, barred owls, direct fatalities, and climate change.

Two primary reasons cited for the original listing of Mexican spotted owl in 1993 included historical alteration of its habitat as the result of timber-management practices and the threat of these practices continuing as evidenced in existing national forest plans. The danger of stand-replacing wildland fire was also cited as a threat at that time. Since publication of the 1995 Recovery Plan, USFWS acquired new information on the biology, threats, and habitat needs of the spotted owl. The primary threats to its population in the U.S. (but likely not in Mexico) have transitioned from timber harvest to an increased risk of stand-replacing wildland fire (USFWS 2012b).

5.7 Mancos Milk-Vetch

5.7.1 Species Description

Mancos milk-vetch (*Astragalus humillimus*) is federally listed as endangered with no designated critical habitat (USFWS 1985, 1989) and a G2 species on the NESL (NNHP 2011). Mancos milk-vetch is a tufted, mat-forming perennial that is distinguished by its leaves that have spines along the central veins. It has short stems measuring 0.2 to 0.4 inch (0.5 to 1 cm) tall. The species has compound leaves measuring 0.3 to 0.6 inch (8 to 15 mm) long. The leaflets are pubescent, light green, and oval. Mancos milk-vetch flowers in late April through early May; the flowers are about 0.4 inch (1 cm) long and lavender to purplish with a conspicuous lighter spot in the corolla tube. The fruit is an oblong pod measuring 0.2 inch (5 mm) long that usually produces 4 to 9 seeds and is usually mature by late June (USFWS 1985, 1989).

5.7.2 Life History

The plant is associated with cracks or depressions in sandstone ledges and mesa tops in Point Lookout sandstone at elevations between 5,000 to 6,000 feet (1,500 to 1,800 meters). It is typically found on large, nearly flat sheets of exfoliating whitish-tan colored sandstone on or near ledges and mesa tops in slick rock communities of Point Lookout & Cliffhouse Sandstone. Some evidence suggests that plants growing within cracks or fissures may be less susceptible to drying out during drought periods (Sivinski and Knight 2001). This ability may indicate that the shallow depressions are marginal habitats, occupied only during wet periods (Sivinski 2008). The associated plant community is pinyon-juniper woodland and desert scrub. Plants often found associated with Mancos milk-vetch include mountain mahogany (*Cercocarpus montanus*), cliff rose (*Purshia neomexicana*), Fendler's bladderpod (*Lesquerella fendleri*), and Cottam's milk-vetch (*A. monumentalis* var. *cottamii*).

The populations of Mancos milk-vetch are strongly delineated by the size and extent of the sandstone (USFWS 1989). Mancos milk-vetch forms highly localized populations ranging from 1.5 to 7.6 hectares in size. The population sites range from San Juan County, New Mexico, to Montezuma County, Colorado, and from Mancos Canyon, Colorado, southward just past the San Juan River in San Juan County, New Mexico. Seventeen sites are known: 13 in New Mexico and 4 in Colorado.

5.7.3 Population Dynamics

Mancos milk-vetch monitoring plots have been established on New Mexico State Trust Lands (five plots at Sleeping Rock) and BLM lands (five plots at Slickrock Flats). These plots were annually monitored from 1990 to 1999 and were visited in 2002 and 2008 (Sivinski 2008). In years when germination was high, seedling mortality was significant, usually during the drier months until the summer rainy seasons began. In 1990, 70 percent of seedlings within 2 plots at Sleeping Rock population died during the dry month of June.

It is difficult to count individuals within the plots because plants growing in close proximity to one another coalesce and form one continuous mat. Therefore, counting of individual mats may not represent the total number of genetic individuals within the monitoring plots and/or populations. Cover values of Mancos milk-vetch were used to assess population vigor within these monitoring plots. Total cover values fluctuated widely during the years of this study. Starting with relatively low cover values in 1990, the 2 populations increased and peaked in 1993 and then decreased to another low point in 1996. Both populations were recovering and increasing when data were last taken in 1999. In 2002, total cover had decreased and fewer seedlings were detected. By 2008, 90 percent of the plots had decreased cover values (below the 2002 values) and the overall cover values from both the populations were at the lowest levels recorded during the timeframe of this study (Sivinski 2008).

5.7.4 Status and Distribution

The range of Mancos milk-vetch is about 40 miles long and a few miles wide. From north to south it comprises mesa edges above the Mancos River, Colorado, to the New Mexico border, then southeast to the Farmington Hogback, south across the San Juan River and down the hogback to east of Little Water, New Mexico. Its distribution on the Navajo Nation within San Juan County, New Mexico, is reported to extend from Palmer Mesa east to the Hogback area and south of the San Juan River, to a hogback east of Little Water. Its' potential distribution within the Navajo Nation includes all slickrock formations of Point Lookout & Cliffhouse Sandstone and possibly other related members in the Four Corners area (AECOM 2013d,e).

There are 12 populations of Mancos milk-vetch on the Navajo Nation. All of these populations were visited by the botanist from the Navajo Natural Heritage Program (NNHP) during the springs of 2007 and 2008. As of 2008, only 2 of the populations had more than 50 plants. Previous survey work done in 1986 and 1989 had recorded densities of more than 500 plants in several of the existing populations. By 2008, these specific populations had less than 100 plants. The majority of plants observed at all the populations were small to medium in size and very few seedlings were observed. Many dead plants were observed, living plants were widely scattered over suitable substrate, and quite a bit of suitable, unoccupied habitat seemed to exist. Currently, less than 400 plants are on the Navajo Nation. The botanist hypothesized those populations of Mancos milk-vetch declined due to drought conditions during 2001, 2002, and 2003 (Roth 2008a). This trend is also reflected in the observed declines on the Sivinski monitoring plots.

The New Mexico populations appear to be declining. All of the populations surveyed and/or monitored have showed significant declines in numbers, cover, and germination and seedling establishment. Drought seems to be a contributing factor in this observed decline. The two populations monitored by Sivinski were in years where there was a significant decline in overall cover, but the populations recovered during wet periods.

Colorado has four known populations, but no recent data are available on the status of those populations. All of these populations are on the Ute Mountain Ute Indian Reservation and access is restricted. A population estimate from 1989 indicated that there were approximately 4,400 plants within the 4 populations in Colorado (Colorado Natural Heritage Program (2007).

5.7.5 Critical Habitat

Mancos milk-vetch was listed as endangered with no critical habitat designated in 1985. No critical habitat has been designated since its listing.

5.7.6 Identified Threats

At the time of listing, the threats were known to be habitat fragmentation and degradation, and destruction from oil and gas development, construction and maintenance of transmission lines, and low number of populations (four) increasing the extinction risk due to stochastic events. Even though the number of populations has increased, the threats remain. Oil and gas development continues in Mancos milk-vetch habitat and many of the populations have decreased in density, likely related to prolonged periods of drought (USFWS 2011c).

5.8 Mesa Verde Cactus

5.8.1 Species Description

Mesa Verde cactus (*Sclerocactus mesae-verdae*) is federally listed as threatened with no designated critical habitat (USFWS 1979, 1984, 2008) and a G2 species on the NESL (NNHP 2011). Mesa Verde cactus is a small, globose, usually single-stemmed plant 1.5 to 3.5 inches (3.2 to 9 cm) in diameter. Each stem has 13 to 17 ribs. Although single-stemmed plants are most common, mechanical damage from insects or mammals may create plants with multiple stems (Ladyman 2004). In years of normal precipitation, stem diameter growth is about 0.05 to 0.1 inch (2.6 mm) per year (CNAP 2005). Once the stems grow to about 3.5 inches (9 cm), growth essentially stops, and they tend to increase or decrease by as much as 0.6 inch (1.5 cm) in diameter in response to wet and dry years (CNAP 2005). The spines are 0.25 to 0.50 inch (6 to 13 mm) long in clusters of 8 to 11. The flowers are about 0.75 inch (2 cm) in diameter, cream to yellow-colored, and bloom in late April to early May. The seeds are black and 0.09 inch (2.5 to 3 mm) long (USFWS 1984).

Mesa Verde cactus is distinguished from other cacti of the Sclerocactus genus by an almost total lack of central spines. This species has gray-green to pale green stems that are depressed-globose to oval in shape (Heil and Porter 1994) and typically produces yellowish-cream flowers, although extreme southern populations tend to produce pink flowers. Mesa Verde cactus is typically found on or near clay hills at elevations ranging from 4,900 to 5,500 feet associated with the Fruitland and Mancos Shale geological formations (Heil and Porter 1994). It is most frequently found on the tops of hills or benches and along slopes in salt-desert scrub communities. The western extent of the Mancos and Fruitland formations are located in western San Juan County, New Mexico, and southwestern Montezuma County, Colorado. The range of Mesa Verde cactus is roughly defined by Cortez, Colorado, on the northern boundary, Sheep Springs, New Mexico, on the southern boundary, the Chuska and Carrizo Mountains in New Mexico along the western border, and Kirtland, New Mexico, and the Chaco River along the eastern boundary. Plants often found associated with Mesa Verde cactus include mat saltbush (*Atriplex corrugata*), prickly pear cactus (*Opuntia polyacantha*), shadscale (*Atriplex confertifolia*), and frankenia (*Frankenia jamesii*) (BIA 2008).

5.8.2 Life History

Mesa Verde cactus is a long-lived (over 40 years), slow-growing perennial (Ladyman 2004). The flowers possess both stamens and ovaries and are partially self-compatible. Vegetative reproduction also occurs through stem sprouts. Pollinators appear to be primarily bees in the family Halictidae. Stems begin producing flowers when they are approximately 0.8 inch (2.0 cm) in diameter, and the number of buds, flowers, and fruits are positively correlated with stem diameter (Coles 2003). On average, each Mesa

Verde cactus produces 200 seeds, with approximately 20 to 30 seeds per fruit (USFWS 1984). Seeds are most likely distributed through rain runoff, but wind and ants may also be important in distribution (Ladyman 2004). Seeds ripen in late May to early June, but the seed coat must be scarified before germination will occur. Freezing and thawing apparently cracks the seed coat (Ladyman 2004). Germination and successful seedling establishment have been observed during years of normal or better than average annual precipitation (Sivinski 2003; Coles 2004). Seedling mortality and lack of germination were noted during periods of severe drought (Sivinski 2003; Coles 2004).

The Mancos and Fruitland formations where Mesa Verde cacti grow erode easily, forming low, rolling hills. The soils have high alkalinity, are gypsiferous, and have shrink-swell properties that make them harsh sites for plant growth.

5.8.3 Population Dynamics

Cactus density varies greatly within populations; as many as 20 cacti may grow within a 50-square-meter area or only a single specimen for several hundred meters. It typically occurs on small, eroded hills and ridges in groups, the size of which may also vary: from less than 10 to more than 200 plants. Adjacent clusters of cacti may be very close or widely separated by several km of what appears to be suitable but unoccupied habitat.

Average mortality rates varied from 5 to 10 percent with rare die-offs of up to 25 percent or more (Coles 2003; Ladyman 2004). A consistent source of mortality was desiccation of stems less than 0.4 inch (1.0 cm). Periodic insect infestations caused most mortality (Coles 2003). Most years had low recruitment and mortality, punctuated by significant reproduction and recruitment events at infrequent intervals.

The 1984 Recovery Plan estimated about 5,000 to 10,000 Mesa Verde cactus plants (USFWS 1984). Additional populations were subsequently discovered on the Navajo Nation, and by 1999 field botanists working with this plant estimated the total number of Mesa Verde cacti was at least twice the original estimate, if not more (USFWS 2008). Fluctuations in the monitored natural populations appeared to be normal and relatively stable until 2002 to 2003, when a significant die-off of adult cacti occurred. A long-term drought began in the early 2000s that resulted in increased insect attacks on the species when 2002 to 2003 species populations declined by 80 percent in New Mexico (Muldavin et al. 2003).

The NNHP began monitoring Mesa Verde cactus in 1992 at 3 different sites. Intensive sampling at 1 site was discontinued due to poor sampling design in 2002, although general population updates continue to be collected (USFWS 2008). Additional study plots were established on the Navajo Nation near Shiprock and Sheep Springs, New Mexico, but these sites were monitored for only 2 or 3 years and then were eliminated from the monitoring effort. By 2004, all but 6 Mesa Verde cacti had died in the monitored plots, and formal monitoring was discontinued (USFWS 2008). No Mesa Verde cacti were found at the Sheep Springs site from 2004 to 2006, and the population may be extirpated.

BLM biologists estimated greater than 80 percent mortality from insect damage on plots that they monitor (BLM 2003a). Sivinski (2003) found most mature cacti at the Waterflow plots had been killed by beetles. The highest population density in this plot was 235 individuals in 1999, which was reduced to 74 individuals by 2003. Coles (2003) documented a less severe reduction of 20.4 percent of cactus numbers in two Colorado plots. However, 96 of 535 living stems were judged to be in poor condition in 2003 and were expected to die before April 2004, for a 2-year mortality figure of almost 36 percent (Coles 2003).

In 2004, Ladyman conducted extensive surveys on Navajo lands for the NNHP. Sites of prior occurrences were re-surveyed, along with seven new sites where suitable habitat appeared to exist (Ladyman 2004). Unlike past surveys, at no site were hundreds or even thousands of Mesa Verde cacti found. As an example, near Many Devils Wash, the survey team found 27 plants; 23 were dead and 4 alive (a 99.7 percent decrease from the 1,500 or more individuals reported at the site in 1989) (Ladyman 2004). More than 56 areas covering more than 7 sections (about 4,723 acres) within Navajo Nation lands were surveyed in 2004. Several of these sites once had more than 1,500 cacti; the 2004 survey found that few sites supported more than 20 individuals. The total number of plants counted at all sites surveyed was 948 live cacti, 428 dead cacti, and 20 damaged cacti, whose viability was questionable (Ladyman 2004).

Continued monitoring indicates that Mesa Verde cactus populations are slowly increasing. In Colorado, relatively slow recovery has been documented (CNAP 2005). Although the number of stems sprouting from cacti damaged by beetle attack during the drought increased, the number of seedlings was far less than expected (seven in 2004, three in 2005) in spite of average or above average precipitation (CNAP 2005). Two hypotheses have been suggested to explain the lack of seedling recruitment. First, nurse plants (plants that create less harsh conditions in which cacti may grow) such as mat saltbush (*Atriplex corrugata*, *A. gardneri*, *A. confertifola*) have not recovered from the drought. Second, Mesa Verde cactus seeds may be short-lived and the seed bank may be exhausted because of virtually no reproduction during the drought (CNAP 2005).

In New Mexico, the Waterflow plot currently has 113 plants compared to 74 in 2003. However, in 2007, only 2 of the plants were larger than 6 cm, compared to 28 in 1999 and 5 in 2003 (USFWS 2008). Since reproductive output is directly related to size of plant, reproduction potential remains limited. Some areas like Sheep Springs, where no plants have been documented since the drought, may be permanently affected. Other areas, such as Malpais Conservation Area, show signs of recovery. In 2004, 116 plants were found across 300 acres in the Malpais Conservation Area (Ladyman 2004). A survey conducted in 2006 found 350 live plants within the Conservation Area and about 1,022 cacti east of the area along the previously proposed alignment for the Navajo Transmission Project (Ecosphere 2006). However, it is not known if the methods and area covered by the 2004 and 2006 surveys were similar. These surveys indicated that there were at least 1,300 plants in and near the Malpais Conservation Area. In sites monitored for transplant success, mortality rates have decreased since 2003 and new plants continue to be recruited into the population, although at a very low level (Roth 2008b).

5.8.4 Status and Distribution

The distribution of Mesa Verde cactus encompasses a roughly rectangular area extending north to south from about 15 miles north of the Colorado-New Mexico border to the vicinity of Sheep Springs, New Mexico, and east to west from the vicinity of Waterflow, New Mexico, to about 15 miles west of Shiprock. Plants can occur sporadically anywhere that soils are suitable, but five areas of concentration appear to exist. These areas are near the base of the Mesa Verde Escarpment in Montezuma County, Colorado, near the Colorado-New Mexico state line, in the vicinity of Shiprock, in the vicinity of Sheep Springs (although the current condition of this population is unknown), and north of Waterflow. The New Mexico plants are concentrated in north-central San Juan County.

Most Mesa Verde cactus populations occur on tribal lands. Approximately 70 percent of occurrences are on the Navajo Nation and another 20 percent on the Ute Mountain Ute Indian Reservation. As of 2004, more than 56 areas covering 4,723 acres on the Navajo Nation had been identified as supporting Mesa Verde cactus at one time (Ladyman 2004). On the Navajo Nation, the majority of plants are within a 20-mile radius of Shiprock. Historically, an additional population was found in the Sheep Springs area. The other 10 percent of the populations occur east of the Hogback on private lands and on public lands administered by the BLM Farmington Field Office. Plots monitored on BLM lands declined by 97 percent between 2002 and 2003 (BIA 2008). Ladyman (2004) documented several sites that had historical occurrences and no live plants in 2004, due to oil field development, housing subdivision, agricultural development, and livestock use.

Between 2002 and 2003, Mesa Verde cacti numbers declined dramatically across its range. Mesa Verde cactus distribution on the Navajo Nation where the species was previously documented covers approximately 4,723 acres. More than 1,500 individuals were recorded at several sites prior to 2002; however, only 948 cacti were counted in 2004. The 2004 survey recorded few sites supporting more than 20 individuals (Ladyman 2004).

Because of recent drought conditions and concurrent pressures of insect herbivory within the range of Mesa Verde cactus, many known populations have suffered significant reductions and, in some cases, possible extirpation of individual populations. Because of the slow growth rates and cryptic habits of seedlings, the results of these effects on Mesa Verde cacti would not become evident for several years after better climatic conditions return. It is likely that seeds of Mesa Verde cacti survive in the seed bank present in many of these sites, awaiting the return of more favorable conditions.

5.8.5 Critical Habitat

Mesa Verde cactus was federally listed as threatened in 1979 (USFWS 1979). No critical habitat was designated at the time of listing and nor has critical habitat been designated for this species since.

5.8.6 Identified Threats

The 1984 Recovery Plan (USFWS 1984) recommended that a program be developed for artificial propagation of Mesa Verde cactus. Recommendations included developing improved artificial propagation techniques, providing stock to outlets for commercial use, and developing a program for salvage of individual Mesa Verde cacti that are unavoidably threatened with destruction (USFWS 1984). Unfortunately, Mesa Verde cactus has proved to be difficult to cultivate (USFWS 2008). As many as 90 percent of the plants collected may rot and die within the first year (USFWS 1984). Precise conditions are needed for successful germination, cultivation, and survival, and it is especially difficult to cultivate in areas of high humidity because the stem is particularly susceptible to rot (USFWS 2008).

When listed, existing or potential threats included coal, oil, and gas exploration and production; commercial and residential development; road, power line, and pipeline construction; commercial and private collecting; ORV effects; livestock trampling; and disease and predation. These threats have continued since listing and additional studies have been conducted to assess impacts associated with insect predation and drought.

Predation by the cactus borer beetle (*Moneilema semipunctatum*) causes significant fluctuations in Mesa Verde cactus populations. The beetle is a specialist on cactus. Adult beetles lay eggs at the base of the cactus stems, and upon hatching the larvae bore into the stem, usually killing the plant. Three significant mortality events caused by the beetle were recorded during long-term monitoring in Colorado (Coles 2003). During an outbreak, most stems greater than 0.8 inch (2 cm) were killed, but plants from 0.24 to 4.0 inch (0.6 to 10.4 cm) in diameter were attacked. About 15 percent of the plants survived attacks and subsequently sprouted (Coles 2003). The beetle caused widespread mortality to Mesa Verde cactus populations in association with a severe drought in 2001 to 2002. Increased mortality could have resulted from weakened plants due to water stress, increased numbers of beetles due to drought, or from the beetles targeting Mesa Verde cactus over other cactus species.

Over a 19-year period, average mortality rates varied from 5 to 10 percent with atypical mortality events greater than 25 percent on 3 monitoring plots on Ute Mountain Ute lands. The main cause of mortality was predation by the longhorn beetle. Monitoring plots on the Navajo Nation also experienced this pattern of relative stability with periodic fluctuations (Ladyman 2004).

The army cutworm (*Euxoa* sp.) has also been associated with predation on Mesa Verde cactus. The caterpillars chew through the cactus stems. In 2003, many of the Mesa Verde cacti on the BLM Farmington Resource District were infested with cutworms that were eating both the stem and roots. It is not known if the cutworm is a typical predator on the cactus or if the drought caused the infestation.

Between 2003 and 2007 the number of Mesa Verde cactus in BLM monitoring plots increased approximately 65 percent overall, from a total of 10 in 2003 to 25 in 2007 and the monitoring shows a slow recovery is occurring (BIA 2008). In Colorado, between May 2003 and April 2004 a 24.5 percent increase in stems occurred, almost entirely due to continued sprouting of stems damaged by longhorn beetles and other agents during the drought (Coles 2004).

5.9 Fickeisen Plains Cactus

5.9.1 Species Description

Fickeisen plains cactus (*Pediocactus peeblesianus* var. *fickeiseniae*) is federally listed as endangered with designated critical habitat (78 FR 60607; October 1, 2013) and is a G3 species on the NESL (NNHP 2011). Fickeisen plains cactus is a rounded cactus, the size of a quarter that retracts below ground during the winter and summer months. Stems of mature plants are 1.0 to 2.6 inches (2.5 to 6.5 cm) tall and up to 2.2 inches (5.5 cm) in diameter. They are covered with tubercles that form a spiral pattern around the plant. Each tubercle has 6 to 7 radial spines that are spongy with a long central spine (0.59 to 0.70 inch (1.5 to 1.8 cm) that is strongly curved. Flowers are creamy white and bloom from mid-April to mid-May; fruiting occurs from mid-May to early June. The cactus then retracts below ground and can become buried by surface gravel making detection difficult outside the flowering period (USFWS 2013e).

5.9.2 Life History

Fickeisen plains cactus grows on shallow gravelly soils of Kaibab limestone on the margins of canyons or well drained hills in Navajoan Desert, Great Basin Desert scrub, and Great Plains Grassland. Plant species commonly associated with this cactus are broom snakeweed *(Gutierrezia sarothrae)*, fourwing saltbush (*Atriplex canescens)*, winterfat (*Eurotia lanata)*, blackbrush (*Coleogyne ramosissima)*, Mormon tea (*Ephedra viridis)*, desert trumpet (*Eriogonum inflatum)*, *Forsellesia nevadensis* (no common name), California buckwheat (*Eriogonum fasciculatum)*, Cottontop cactus *(Echinocactus polycephalus* var. *xeranthemoides)*, black-spine claret-cup hedgehog cactus *(Echinocereus triglochidiatus* var. *melanacanthus)*, Spiny star cactus *(Coryphantha vivipara)*, Missouri foxtail cactus *(Coryphantha missouriensis)*, prickly pear cactus *(Opuntia* spp.), New Mexico feathergrass *(Stipa neomexicana)*, James' galleta *(Hilaria jamesii)*, Indian ricegrass *(Oryzopsis hymenoides)*, Fremont's pincushion *(Chaenactis fremontii)*, and Indian paintbrush *(Castilleja chromosa)*.

Endemic to Colorado Plateau the species is known to occur in widely scattered, small populations on the Colorado Plateau in Coconino and Mohave counties. The range of the cactus encompasses the Arizona Strip (i.e., the area north of the Colorado River to the Arizona-Utah border) from Mainstreet Valley in Mohave County to House Rock Valley in Coconino County, along the canyon rims of the Colorado and Little Colorado rivers, to the area of Gray Mountain, and along the canyon rims of Cataract Canyon on the Coconino Plateau.

5.9.3 Population Dynamics

Fickeisen plains cactus occurs in widely scattered, small populations on the Colorado Plateau in Coconino and Mohave counties at elevations between 4,200 and 5,950 feet. About 1,100 Fickeisen plains cacti among 33 populations have been documented rangewide since the species' discovery in the late 1950s. The historic range of the cactus is unknown but likely similar to the current distribution. The species seems to have low reproductive capacity, even during favorable weather conditions (USFWS 2013e).

5.9.4 Status and Distribution

Fickeisen plains cactus is restricted to small, isolated populations that grow in soils derived of Kaibab limestone on the Colorado Plateau in Coconino and Mohave counties, Arizona. The species habitat is within the Plains and Great Basin grasslands and Great Basin desert scrub vegetation communities at elevations between 4,200 to 5,950 feet (1,280 to 1,814 meters). Populations occur in shallow, gravelly, and well-drained soils derived from exposed layers of Kaibab limestone. Plants are found on the margins of canyon rims, flat terraces or benches, or the toe of well-drained hills with less than 20 percent slope.

About 1,100 Fickeisen plains cacti among 33 populations have been documented rangewide since the species' discovery in the late 1950s. The cactus occurs on lands managed by the BLM, U.S. Forest Service, Navajo Nation, and Arizona State Land Department. It also occurs on private land. Its range in

Coconino County, Arizona, is from House Rock Valley and Gray Mountain to the Little Colorado and Colorado rivers. Within the Navajo Nation, the species is found from Gray Mountain to southwest of Bitter Springs, Coconino County. It also is potentially found on the Navajo Nation from Marble Canyon to Gray Mountain. (Roth 2008a)

5.9.5 Critical Habitat

Fickeisen plains cactus was listed as endangered with critical habitat designated in 2013. Critical habitat is being proposed for a total of 19,066 hectares (47,123 acres) in Coconino and Mohave counties (78 FR 40673). The cactus is also protected by the Arizona Native Plant Law as a highly safeguarded native plant.

5.9.6 Identified Threats

The USFWS first identified Fickeisen plains cactus as a candidate for ESA protection in 1980. Current threats include trampling by livestock, non-native invasive species, rodent and rabbit herbivory, drought, and climate change that exacerbate the effects of small population size. Monitoring data from a limited number of sites representing the majority of the rangewide population indicate significant population declines due to several threats acting together. Additional threats are collection, habitat disturbance from ORVs and road maintenance; all compounded by drought and climate change (USFWS 2013e; Benson 2014).

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6 Environmental Baseline

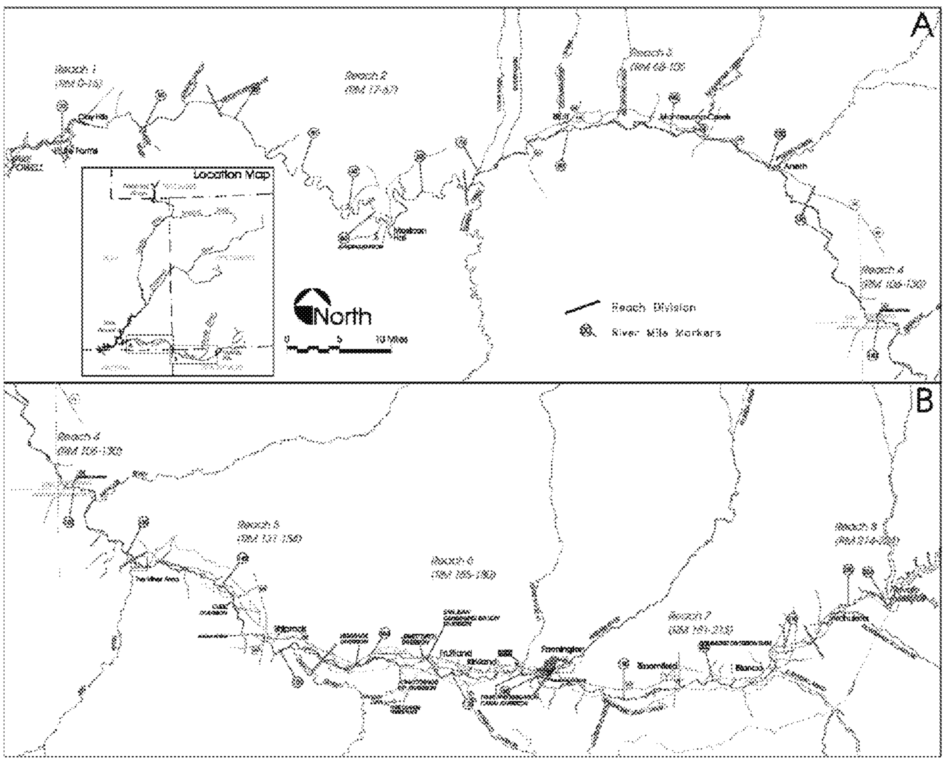
6.1 Status of the Species within the Action Area

6.1.1 Colorado Pikeminnow

Colorado pikeminnow in the San Juan River have been affected by the construction of Lake Powell, Navajo Dam, several smaller diversion structures, and development within the basin. Navajo Dam has altered the flow, temperature, and sediment regime in the river downstream. The first 10 km below the dam have dramatically lower suspended sediment concentrations than any other area of the river, and the temperatures below the dam do not reach equilibrium with atmospheric temperatures for about 100 km (USFWS 2002a). As discussed in Section 5.1.5, critical habitat in the San Juan River encompasses the river and 100 year flood plain from New Mexico State Route 371 to the full pool elevation at the mouth of Neskahai Canyon on the San Juan arm of Lake Powell. Colorado pikeminnow are currently found from near the confluence of the Animas River downstream to Lake Powell, although temperatures in the upper reach of this area may be colder than the species prefers (Durst and Franssen 2014).

Cudei Diversion has been removed, and fish passage has been provided at the Hogback Diversion in 2001 and the PNM Weir in 2003. Colorado pikeminnow have been documented to successfully use these facilities (Morel 2012).

From 1991 to 1997, it was estimated that there were fewer than 50 adult Colorado pikeminnow in the San Juan River, and in 2000 it was estimated that there were about 19 wild adults from RMs 119 to 137 (Figure 6-1). No wild pikeminnow adults have been captured since 1999 (Schleicher and Ryden 2013).



(Source SJRRIP 2014 http://www.fws.gov/southwest/sjrip/pdf/DOC_sanjuanmap.pdf accessed 6/27/2012)

Figure 6-1 San Juan River Locations

Colorado pikeminnow populations in the San Juan River are supported by stocking with hatchery-reared fish to try to reestablish a population in this river. Approximately 3.2 million pikeminnow were stocked between 2002 and 2011 (Furr 2012). More Colorado pikeminnow (433) were caught during the large-bodied fish monitoring effort in 2010 than in any previous effort (Ryden 2012). In the 2012 monitoring event, 272 pikeminnow were captured (Schleicher and Ryden 2013) and over the last several years the SJRRIP has captured several hundred stocked pikeminnow of varying sizes (Furr 2012). Catch per unit effort (CPUE) of fish that had been in the river for one or more winters has an increasing trend since 2003, but this trend is mainly a reflection of Age 0+ fish (fish within their 1st year after birth) surviving to recapture at Age 1+ (fish that are 1 year old). The number of larger fish remains small, although the number of these larger fish continues to increase.

The increasing trend in CPUE is likely the result of better stocking procedures. Schleicher and Ryden (2013) estimated that close to 1,000 pikeminnow > 300 mm TL may be in the river (based on capture of 22 individuals of this size), which is one of the delisting criteria for this species in the San Juan River (although these fish were not wild fish). The observation of adult fish proves that some of the stocked fish are surviving. Between the large-bodied fish monitoring program and the more intensive non-native fish removal program 29 adults were captured in 2012, which substantially exceeds the total of 17 adults captured between 1991 and 1994. It is also nearly double the 15 adults that indicate the adult population is approaching the level specified in the Recovery Plan for delisting (Schleicher and Ryden 2013; USFWS 2002a).

Population estimates for Colorado pikeminnow were generated in 2010, using three complete riverwide non-native fish removal passes made in 2010. Two separate models yielded the following population estimates: 5,418 (CI = 4,049-7,549 Model M(t)) and 5,466 (CI = 4,082-7,614, ; Model M(o)). Only age 2+ Colorado pikeminnow that had been in the river for 1 over-winter period were used in this estimate, so the total number of Colorado pikeminnow will be higher than these estimates.

While the numbers of stocked subadult and adult pikeminnow may be approaching the levels for downlisting or delisting in the Recovery Plan, the criteria for a self-supporting wild population have not been met. Low numbers of larval pikeminnow collected over the last several years give some indication that reproduction in the wild is occurring, although not at levels sufficient to support the population. Additionally, the species also appears to be expanding its range within the basin upstream of the Hogback and PNM weirs, and into McElmo Creek (Schleicher and Ryden 2013) (Figure 6-1).

In spite of these positive trends, the species' long-term viability remains uncertain because of the relatively limited habitat available between Navajo Dam and Lake Powell, competition and predation from non-native fishes, water quality issues, and the uncertainty surrounding the changes that climate change will bring to the San Juan River Basin.

6.1.2 Razorback Sucker

Razorback sucker in the San Juan River have been subject to the same environmental conditions described above for Colorado pikeminnow. The direct loss of 161 km of habitat is due to the completion of Lake Powell and Navajo Reservoir, associated changes in hydrology, temperature and water quality, blockage of passage, and predation and competition from non-native fish. As discussed in Section 5.2.5, critical habitat for razorback sucker in the San Juan River has been designated from Hogback Diversion downstream to Lake Powell.

The population is supported by stocking of hatchery-reared fish. Between 2009 and 2012, the number released has ranged from 8,418 to 28,485, with an average of 17,889 razorback suckers released per year (Furr 2013). The CPUE from 2010 to 2012 is significantly higher than that observed from 2003 to 2004, indicating greater numbers of razorback sucker are present in the river (Schleicher and Ryden 2013). It is clear from the monitoring data that these fish are capable of surviving in the river for as long as 15 years. Larval razorback sucker have been collected consistently for 15 consecutive years, indicating that spawning is occurring. Unfortunately, few Age 1 to Age 2 razorback sucker have been captured during monitoring. Razorback sucker of this age are difficult to detect, but a consistent lack of detection indicates that few razorback sucker of these age classes are in the river. The reasons for this lack of recruitment to these age classes is unknown (Schleicher and Ryden 2013). Population estimates for fish that had been in the river for at least one winter were calculated from 2010 data using two models. Model m(t) yielded population estimates of 2,928 (confidence interval: 1,952 to 4,796); and Model M(o) provided a population estimate of 3,021 (confidence interval: 2,007 - 4,940) (Schleicher and Ryden 2013).

Monitoring in the San Juan River indicates that razorback sucker are expanding their range upstream above the PNM Weir and into tributaries such as McElmo Creek and Chaco Wash (Schleicher and Ryden 2013).

6.1.3 Southwestern Willow Flycatcher

The breeding range of southwestern willow flycatcher extends into the Action Area; however, no nesting southwestern willow flycatchers have been documented in the Action Area. Only one known historic breeding territory for southwestern willow flycatchers is in San Juan County; this location occurs along the San Juan River northwest of the Proposed Action 15 miles downstream of Shiprock, New Mexico (BNCC 2012b). Migrants have been documented on rare occasions along the San Juan River, Rio Puerco River, and Morgan Lake during previous surveys (Marron 2012a, b). Migrants have the potential to occur in the Action Area from May to August and are most likely to occur along riparian corridors in the San Juan River, Rio Puerco River, and Morgan Lake. Maps of suitable habitat for southwestern willow flycatcher based on the habitat model constructed by AECOM (2013d) are provided in Appendix C.

No critical habitat for southwestern willow flycatcher exists in the San Juan River, Rio Puerco River, or Morgan Lake watersheds. The nearest designated critical habitat for this species is located along the Rio Grande corridor, which lies to the east of the Action Area and outside the Deposition Area. The San Juan River, Rio Puerco River,[17] and Morgan Lake represent the only perennial water resources within the Action Area that provide potential riparian nesting habitat for southwestern willow flycatcher; however, no nesting southwestern willow flycatchers have been documented. As none of these areas are documented to support nesting southwestern willow flycatchers, these portions of the San Juan River, Rio Puerco River, and Morgan Lake would be considered marginally suitable stopover habitat for migrating southwestern willow flycatchers. Small ponds and ephemeral drainages within the Action Area do not contain year-round water and have limited riparian habitat, which lacks the density, width, and structure to be considered potential nesting habitat. These areas would also be considered potential marginal stopover habitat for migrating southwestern willow flycatchers.

Surveys for southwestern willow flycatcher have been completed regularly in portions of the Action Area and its vicinity since 1998 in association with previous permitting for the various mining, power generation, and energy transmission projects, and recently conducted around Morgan Lake and the DFADA. During this time, this species has been detected sporadically in the general vicinity of Morgan Lake and the San Juan River; however, no confirmed nesting locations of this species have been reported in the Project vicinity. One southwestern willow flycatcher was detected in 2012 during an unrelated project survey near the proposed DFADA (Ecosphere 2012a). Avian surveys in the vicinity of Navajo Mine have been ongoing since 1975 (BNCC 2012b; Ecosphere 2013). This species has never been documented within the Navajo Mine, as a result of the surveys. Because of the marginal quality of habitat, no species-specific or protocol surveys for southwestern willow flycatcher have been conducted within the Navajo Mine since 1995; however, regular avian surveys continue to be part of the mine's wildlife monitoring program. AECOM habitat modeling and site specific field habitat verification was completed in 2013 in discreet locations for the length of the APS transmission lines in the Action Area. Site-specific surveys for the PNM transmission lines were conducted in 2012 along the FCPP to Rio Puerco Switchyard and FCPP to San Juan Switchyard transmission line corridors (Marron 2012a, b).

[17] The Rio Puerco may not support perennial flows in drier years in the vicinity of the PNM FW line.

Eleven Southwestern willow flycatcher surveys were conducted in 1994 and 17 surveys were completed in 1995 in the general Project vicinity along the San Juan River. None of these surveys documented nesting southwestern willow flycatchers.

Within the Navajo Mine Lease Area and Pinabete Permit Area only marginally suitable migratory stopover habitat is present. This habitat is confined to Cottonwood Arroyo, Chinde Wash, Pinabete Arroyo, and a small stock pond in the southern portion of the Pinabete Permit Area (BNCC 2012b). These areas lack the vegetative structure and density to support breeding southwestern willow flycatchers, and the habitat lies more than 330 feet (100 meters) from water, which does not meet the hydrologic parameter for suitable habitat. Because of the marginal quality of habitat, no species-specific or protocol surveys for southwestern willow flycatcher have been conducted within the Navajo Mine since 1995.

Due to the marginal quality of southwestern willow flycatcher nesting habitat in the Action Area around the FCPP and the extended time period anticipated between the baseline evaluation and proposed construction in the survey area, no species-specific or protocol surveys for southwestern willow flycatcher were conducted by APS for this baseline evaluation for the FCPP. Although no species-specific surveys have been conducted around the FCPP, southwestern willow flycatchers have been documented as sporadic migratory visitors within the riparian vegetation around Morgan Lake (Marron 2012b). Such visitors are not expected to be present in the area for more than 2 weeks a year. No nesting southwestern willow flycatchers have been documented in the vicinity of the FCPP or Morgan Lake. Approximately 85 acres of potential poor quality habitat for southwestern willow flycatcher occurs within the DFADA survey area. This habitat includes poor quality, marginally suitable migratory stopover habitat in the ephemeral drainages located in the southern portion of the DFADA, just east of the Chaco River, and in the dense salt cedar stands located at the base of the existing Ash Disposal Area. These stands, which contain dead and dying salt cedar, are considered to be low suitability habitat not appropriate for nesting (Ecosphere 2012a). These areas lack the vegetative structure and density to support breeding southwestern willow flycatchers and the habitat lies more than 330 feet (100 meters) from water, which does not meet the hydrologic parameter for suitable habitat.

Southwestern willow flycatcher migratory stopover habitat was identified during the 2012 surveys for the APS transmission lines (AECOM 2013d), 34.3 acres of marginal migratory stopover habitat was field verified along the 500-kV line west of U.S. Highway 491, along the 500-kV line at the Little Colorado River, and along the 345-kV line east of U.S. Highway 491 and south of Shiprock, New Mexico. No suitable breeding habitat was identified. Areas associated with the APS transmission line were identified as having no suitable nesting or suitable migratory stopover habitat for southwestern willow flycatcher (AECOM 2013d). Along the PMN ROWs, marginal southwestern willow flycatcher habitat is located near the FCPP to West Mesa Switchyard transmission line in the channel of the Rio Puerco River between poles FW 757 and 758 (Marron 2012a), and riparian habitat directly outside the ROW on the floodplain of the San Juan River between poles FC23 and 34. The Navajo Nation has also identified this second patch or riparian habitat.

Formal southwestern willow flycatcher protocol surveys were completed within potential southwestern willow flycatcher habitat within a marshy area located at the northeastern corner of Morgan Lake (west of poles FC46 and 47), as well as at the FC transmission line crossing of the San Juan River (Marron 2012b). Results documented one southwestern willow flycatcher during the first protocol survey, but failed to re-locate this individual during the second protocol survey.

6.1.4 Yellow-Billed Cuckoo

The breeding range of yellow-billed cuckoo extends into the Action Area; however, no nesting yellow-billed cuckoos have been documented in the Action Area. In New Mexico, the species was historically rare statewide, but common in riparian areas along the Pecos River and Rio Grande and uncommon to common locally along portions of the Gila, San Francisco, and San Juan rivers. Historically, yellow-billed cuckoo has been documented as occurring along the San Juan River from Navajo Reservoir to the Arizona state line (New Mexico Partners in Flight 2014). BLM, Farmington Field Office documented this species at five of their San Juan River tract management parcels during 2002 and 2003 surveys between the Hogback and Bloomfield, New Mexico. The closest potential habitat for this species was documented along the San Juan River (Ecosphere 2011); however, given this species documented use of salt cedar, it could occur in the Project Area as a migrant to the Rio Puerco River, Morgan Lake, or where salt cedar and other riparian vegetation occur from May to August.

No habitat capable of supporting yellow-billed cuckoo is present within the Navajo Mine Lease Area or Pinabete Permit Area due to lack of riparian woodland habitats and perennial water resources (BNCC 2012b).

Some marginally suitable habitat for yellow-billed cuckoo occurs in the FCPP Lease Area along the riparian vegetation around Morgan Lake and within the salt cedar vegetation within the DFADA (AECOM 2013d, Appendix C). Field surveys completed for the DFADA identified that no riparian woodland habitats or perennial water sources occur within with DFADA and, therefore, this area is unlikely to support yellow-billed cuckoo (Ecosphere 2012a). Given the existing condition of riparian areas around Morgan Lake and salt cedar vegetation within the DFADA, this habitat would be considered marginal habitat as it occurs adjacent to existing disturbance and consist primarily of exotic riparian tree species. It is possible an occasional yellow-billed cuckoo could use the areas around Morgan Lake or the San Juan River as stopover habitat during migration. If they did, it is anticipated that they would only be present in the area for less than 2 weeks a year.

No suitable nesting or suitable migratory stopover habitat for yellow-billed cuckoo were identified along the APS ROWs (AECOM 2013d). Along the PNM ROWs, areas identified as potentially capable of supporting yellow-billed cuckoo habitat were identified at the Rio Puerco River (FW towers 757-758), San Juan River (FC towers 29-30), and at Morgan Lake approximately 220 meters northwest of FC towers 46-47. Each of these areas were considered to be marginal habitat as it occurs immediately adjacent to existing disturbance regimes and consisted of a dense, low-growing Russian olive trees or salt cedar and lacked overstory structure that yellow-billed cuckoo usually prefers. Suitable habitat along the San Juan River and Morgan Lake were subject to protocol surveys in June and July 2012 (Marron 2012b). No yellow-billed cuckoos were identified during these surveys.

6.1.5 California Condor

This species has not been documented in the Action Area. California condor has been recorded regularly traveling into Utah and portions of Colorado, ranging into eastern Arizona with the nearest known nesting locations occurring along the Vermillion Cliffs and the Grand Canyon, more than 250 miles from the Action Area (Arizona Game and Fish Department 2014). While this species remains undocumented in the Action and Deposition areas, this species is known to travel great distances during long range reconnaissance flights and could occur as an incidental foraging visitor. If California condors were to occur within the Action Area, it is expected that the individual(s) would be a member of the “Nonessential – Experimental” population associated with the Vermillion Cliffs release site and could occur on a rare incidental basis in the Action Area as a result of long-range foraging or reconnaissance. This species would be expected to make use of large open areas for foraging and is expected to avoid developed facilities such as the FCPP, Ash Disposal Facility, and Navajo Mine operations areas. Results of the AECOM (2013d) Habitat Modeling Report identified 2.5 acres of potentially suitable nesting habitat for this species along the APS transmission ROW along portions of the 500-kV APS transmission line and 1,385 acres of foraging habitat along portions of the 500-kV APS line, south of Cameron, Arizona (Appendix C). This species is not documented to occur in the Deposition Area but could occur as a rare foraging visitor to the Deposition Area; as a result, this species was not considered in the ERA

6.1.6 Mexican Spotted Owl

The current distribution and range of Mexican spotted owl extends into both the Action and Deposition areas. This portion of this species range occurs within the Colorado Plateau Ecological Management Unit. Detailed review of Mexican spotted owl site locations identified a site approximately 75 miles northeast of the Action Area (USFWS 2012b). Previous surveys completed as a result of permitting for the Navajo Mine identified the nearest potential Mexican spotted owl habitat as occurring along the New Mexico-Arizona state line within the Chuska Mountains 20 miles west of Navajo Mine. The AECOM habitat analysis also identified this potential habitat along the Chuska Mountains (AECOM 2013d). This potential habitat includes forested habitats along the APS transmission lines, with some of this habitat occurring within the Deposition Area (AECOM 2013d). Surveys completed for BLM Farmington Field Office indicates that no nesting Mexican spotted owls occur within their management territory (BLM 2003b), which encompasses both the Navajo Mine and Deposition Area. This species has not been documented within the mine or Deposition areas.

Studies to identify habitat capable of supporting this species have occurred across the entire Action Area, as a result of past and present permitting and expansion activities. With the exception of Mexican spotted owl habitat identified adjacent to the APS transmission lines (Appendix C), all other Project facilities including the FCPP, DFADA, Navajo Mine, Pinabete Permit Area, and PNM transmission lines lack habitat capable of supporting this species (Ecosphere 2012a, b; AECOM 2013d; BNCC 2012b; Marron and Associates 2012a, b, 2013).

Approximately 33.6 acres of Mexican spotted owl habitat was identified as a result of the 2013 AECOM habitat modeling within the APS ROWs on both the 500-kV and 345-kV transmission lines. Fieldwork completed for verification of this habitat identified that no Mexican spotted owl habitat occurs within the ROW, as large woody vegetation has been removed as an active part of transmission line operation and does not occur within the ROW. A limited amount of suitable habitat occurs in scattered locations adjacent to the APS ROW (AECOM 2013d).

6.1.7 Mancos Milk-Vetch

On the Navajo Nation, Mancos milk-vetch populations are known to extend eastward from Palmer Mesa to the Hogback area and south of the San Juan River to the Hogback east of Little Water. Known populations of Mancos milk-vetch occur about 10 miles southwest of the NTEC Navajo Mine Area IV North (approximately 15 miles southwest of Farmington, New Mexico) outside the Project footprint (BIA 2008; Roth 2008a). The NNHP holds 14 element occurrence records for Mancos milk-vetch, 13 of which are considered to be on Navajo Nation lands.

Mancos milk-vetch also occurs on federal lands managed by the BLM and state lands along and near the Hogback. Intermittent status monitoring has occurred between 2002 and 2008 on established plots. Monitoring data on federal and state lands suggest that demographically a high percentage of Mancos milk-vetch population is composed of juvenile plants. In response to precipitation, and as adults age and die, total density fluctuates from year to year. Seedling establishment is greatest during favorable rainfall years that follow a low point in the cycle of adult plant density. It appears that if adults occupy most of the root space in these substrate limited habitats, then few seedlings can become established. As adult plants die from old age or drought, a subsequent favorable rainfall year will bring on a flush of new seedlings. Mancos milk-vetch populations being monitored on BLM lands indicated another period of decline from 2002 to 2008 (Sivinski 2008).

A review of the special-status plant species list and their potential to occur around the FCPP or within the Navajo Mine and Pinabete Permit areas was conducted and results indicated no suitable habitat or potential for occurrence for Mancos milk-vetch (Ecosphere 2012a, b, 2013).

Six potential habitat locations along the APS transmission line ROWs, as identified by the habitat assessment model (AECOM 2013d,e)(Appendix C), were projected to occur, 2 along the FCPP to Moenkopi transmission line ROW and 4 along the FCPP to Cholla transmission line ROW. Field biologists surveyed these locations in 2013 and 1 population consisting of 8 colonies with 15 individuals total was found along several spans of the FCPP to Cholla transmission line. Some of the colonies covered a large area but only had approximately 20 percent living plants (AECOM 2013e).

No suitable habitat for Mancos milk-vetch occurs along the PNM transmission line ROWs as it requires Cracks of Point Lookout sandstone of the Mesa Verde series at 5,000- to 6,000-foot elevations. This type of sandstone formation does not occur within the PNM transmission line ROWs and the closest formation is 6 to 7 miles to the west.

6.1.8 Mesa Verde Cactus

Most Mesa Verde cactus populations occur on tribal lands (NNHP 2012a, b). Approximately 70 percent of occurrences are on the Navajo Nation and another 20 percent on the Ute Mountain Ute Indian Reservation. The other 10 percent of the populations occur east of the Hogback on private lands and on public lands administered by the BLM Farmington Field Office. As of 2004, over 56 areas existed, covering 4,723 acres, on the Navajo Nation where Mesa Verde cactus had been documented at 1 time (Ladyman 2004).

A review of the special-status plant species list and their potential to occur around the FCPP or within the Navajo Mine and Pinabete Permit areas was conducted and results indicated no suitable habitat or potential for occurrence for Mesa Verde cactus (Ecosphere 2012a, b, 2013).

This species was identified north of San Juan River, where approximately 1,000 to 1,200 acres of good habitat occurs along an existing 230-kV transmission line (BIA 2008). Another population of Mesa Verde cactus is known north of the San Juan River, west of the Hogback. In surveys conducted during Summer 2006, this population was reported to contain 78 dead individuals and 42 live individuals (Ecosphere, unpublished data, as reported in BIA 2008). Other populations have been identified along Navajo Route N-36 and U.S. Highway 491 (USFWS 2011d).

Potential habitat was identified within portions of the APS and PNM transmission line ROWs. Potential habitat for Mesa Verde cactus along the PNM ROWs occurred along 2 segments of the FCPP to San Juan Generating Station transmission line corridor between poles FC38-42 and FC5-18 (Marron and Associates 2012a). However only 4 Mesa Verde cactus population sites were found scattered between structures FC13-18 during surveys conducted in April 2013 (Marron and Associates 2012b).

Mesa Verde cactus surveys conducted by APS in April 2012 identified approximately 204 acres of potential habitat for this species in the survey area (AECOM 2013d,e)(Appendix C). The habitat identification was determined based on evaluation of soil characteristics and vegetation community types found in the survey area. APS biologists completed presence/absence pedestrian surveys for this species in suitable habitat during the blooming period and no Mesa Verde cactus was recorded.

6.1.9 Fickeisen plains Cactus

Fickeisen plains cactus is endemic to a narrow desert range in northern Arizona, including parts of Coconino and Mohave counties and Navajo Nation lands. The cactus occurs on lands managed by the BLM, U.S. Forest Service, Navajo Nation, and Arizona State Land Department. It also occurs on private land. Approximately 35 occurrences are believed extant. Total population size is unknown but could be less than 1,000 plants. This cactus has very specific habitat requirements, low seed production, and a scattered distribution; it is considered naturally rare (Benson 2014).

A review of the special-status plant species list and their potential to occur around the FCPP or within the Navajo Mine and Pinabete Permit areas was conducted and results indicated no suitable habitat or potential for occurrence for Fickeisen plains cactus (Ecosphere 2012a, b, 2013).

The habitat model report identified five special-status plant species that required presence/absence surveys to fill in the data gaps from previously conducted sensitive plant and habitat surveys conducted in 2012 by AECOM. The survey area for the 2013 presence/absence surveys includes selected locations along ROWs of the 345-kV and 500-kV transmission lines where no current surveys for specific species exist.

Five potential habitat locations for Fickeisen plains cactus were identified along the APS 500-kV line ROW by the habitat assessment model (AECOM 2013d,e)(Appendix C). APS biologists surveyed these potential habitat locations in 2013. Approximately 11.5 miles of potential habitat along the 500-kV line ROW was surveyed, with about 6.5 miles of moderate to low quality habitat and 5 miles of low quality habitat. No individuals of the target species were observed during field surveys.

6.2 Factors Affecting Listed Species within the Action Area

6.2.1 Colorado Pikeminnow and Razorback Sucker

The San Juan River drains a basin of approximately 25,000 square miles in southern Colorado and Utah and northern New Mexico and Arizona. The river originates in the mountains of southern Colorado and flows westward to the Colorado River at Lake Powell in eastern Utah. Flow through the Action Area is controlled at Navajo Dam, located at RM 224, about 50 km to the east of Farmington, New Mexico. Navajo Dam is operated by Reclamation (2006). The following discussion of the effects of Navajo Dam is summarized from the Final EIS for Navajo Reservoir Operations (Reclamation 2006) and the associated Navajo Reservoir BO for that project (USFWS 2006) and incorporates all references referred to in those documents.

The major perennial tributaries below Navajo Dam are the Animas, La Plata, and Mancos rivers, and McElmo Creek. Also, numerous ephemeral arroyos and washes that contribute little flow but large sediment loads to the San Juan River. The Chaco River is an intermittent tributary to the San Juan River that passes just to the west of Navajo Mine and FCPP.

6.2.1.1 Stocking

Colorado pikeminnow populations had declined to very low numbers in the 1980s and 1990s. At this time, a stocking program was initiated to boost their numbers and support the populations (USFWS 2002a), with experimental stocking first occurring in 1996. This initial stocking effort was successful, with relatively large numbers of fish found in 1997. Stocking has occurred every year since. Approximately 3.2 million pikeminnow were stocked between 2002 and 2011 (Furr 2012).

Razorback sucker had similarly declined to very low numbers in the 1980 and 1990s. An experimental stocking program was initiated from 1994 to 1996 to gather information about the recovery potential and habitat suitability for the species in the San Juan River. This experiment led to a full-scale stocking program initiated in 1997 and scheduled to continue until 2016. From 1994 through 2012, 130,473 razorback sucker had been stocked into the river. Between 2009 and 2012, the number released has ranged from 8,418 to 28,485, with an average of 17,889 razorback suckers released per year (Furr 2013).

6.2.1.2 Streamflow and Habitat Modification

Navajo Dam was constructed and is operated to provide for irrigation water supply, flood control, regulation of river flow, and recreational and fisheries activities (Reclamation 2006). Navajo Reservoir currently provides water to support agricultural and municipal water supply needs in the San Juan River Basin. The Basin is fully appropriated, meaning that the total volume of allowable diversions cannot increase. However, not all water rights are being fully utilized. Complete use of the existing water rights would nearly double total out-of-stream uses in the future. These uses alter the physical landscape within the basin. Return flows from these uses affect water quality in the San Juan River through contribution of industrial waste, sewage treatment plant discharges, metals, pesticides, and fertilizers. The effects of dams on downstream riverine environments include changes in flow, temperature, and sediment transport regimes. The effect of Navajo Dam on these regimes is described below.

6.2.1.2.1 Transformation of Riverine Habitat into Lake Habitat

Lake Powell inundated the lower 54 miles of the San Juan River and Navajo Reservoir inundated about 27 miles. This inundation reduced the total amount of available habitat by over 30 percent and reduced the number of miles of potential rearing habitat in the lower end of the river (USFWS 2002a, 2006). Lake Powell is also home to several non-native predators. In years when the falls are inundated, these fish may travel up the San Juan and prey upon native species. This factor may be affected by the Proposed Action.

6.2.1.2.2 Flow Changes

Prior to the construction of Navajo Dam, mean monthly flows in the San Juan River ranged from less than 50 cfs during the late summer/early fall to nearly 20,000 cfs in May (USFWS 2006). Spring peak flows of more than 15,000 cfs occurred 25 percent of the time, and the highest peak flow recorded was 52,000 cfs. Construction of the dam decreased peak discharges by more than half and elevated base flows by 168 percent on average. The annual hydrograph became much more constant. The Navajo Reservoir BO (USFWS 2006) identified that average annual flows in the San Juan River at Bluff Utah had been depleted by 30 percent, and that these depletions likely contributed to the decline in Colorado pikeminnow and razorback sucker populations. The Navajo Reservoir BO cited total New Mexico diversions of 617,128 af/yr and total basin diversions of 854,376 af/yr.

Surface water drawn from the San Juan River into Morgan Lake for use at the FCPP is obtained according to water rights for 51,600 af/yr diversion, 39,000 af/yr consumptive held by BBNMC under New Mexico Office of the State Engineer Permit 2838. Average diversions at the APS Weir are 27,682 af/yr. The main uses of water for the FCPP are for heat transfer in the primary cooling systems, for steam production in the turbine systems, and as cooling water for the condenser cooling system. No changes to the water rights or water use would occur under the Proposed Action, and NTEC (and the FCPP) would maintain the ability to draw as much water as the rights allow for the Project life. Future operations are expected to maintain the same level of diversions and consumptive use as historic operations.

Flow recommendations were developed through the SJRRIP during the 1990s to better support populations of native fish, including the listed Colorado pikeminnow and razorback sucker (Holden 1999). Navajo Dam has been operated to meet these flow recommendations since they were published and completed an EIS in support of these modified operations in 2006 (Reclamation 2006), and the USFWS issued a BO for those operations (USFWS 2006). Not all of the water rights considered in the BO were being fully utilized. The BO did not include full utilization of those water rights, but noted that those future diversions would decrease operational flexibility. The BO indicates that the reoperation of the dam provides native fish with the proper cues at the proper times to trigger spawning and appropriate habitat at the appropriate time to support young fish and that the operation of Navajo Dam and the water rights considered would not adversely affect listed species.

6.2.1.2.3 Channel Morphology

The timing and magnitude of flows and the amount of sediment input into the system influences channel form and morphology, which creates habitat for fish and other aquatic organisms. It is believed that the channel of the San Juan River has narrowed considerably since the 1930s as a result of upland habitat degradation and erosion (Holden 1999). These channel changes have been exacerbated by the reduction of high spring peak flows following the closure of Navajo Dam and the spread of exotic salt cedar and Russian olive, which encroach on the low-flow channel when flushing flows of sufficient magnitude are not present to stop this encroachment. This encroachment also may have contributed to a reduction in the number of active secondary channels. Channel complexity increased between 1960 and 1988 to near historical levels, due in part to a number of wet years and despite the closure of Navajo Dam near the beginning of this period. Russian olive became established in the system and spread rapidly during this time. Channel complexity was reported to be stable since 1992 (USFWS 2006).

This narrowing of the channel appears to have stopped or substantially reduced by 1988 (Holder 1999), which may be due in part to higher flows implemented in 1992 to mimic natural flows. The amount of backwater habitat decreased since 1992, relative to the period prior to 1991, but may have been due to an unusually large amount of backwater habitat prior to 1991 as a result of several wet years. The amount of other low-velocity habitats did not change significantly after 1992 (Holden 1999) and channel complexity has remained stable (USFWS 2006).

Navajo Dam's operations have been modified to include flows that support geomorphic processes that contribute to the formation of backwaters and promote channel complexity. However, because of the ongoing drought in the basin, not all of the flow targets in the plan have been met in recent years. The last time all of the flow goals were met was in 2005. The goal of 10,000 cfs for 5 or more days has not been met since then, although 4 days were provided in 2008. The last time the target number of days of flow of 8,000 and 5,000 cfs were met was in 2008. The 2,500-cfs flow target has been met consistently since 2003 (Reclamation 2012).

Narrowing of the channel increases water velocity and decreases the amount of low-velocity habitat important to young Colorado pikeminnow and razorback sucker (USFWS 2006). While habitat does not appear to be limiting to adults (USFWS 2006), it is of concern for larval and juvenile fish.

6.2.1.2.4 Water Temperature

Navajo Dam releases cold water from the reservoir to the river downstream to support a recreational trout fishery in this area. Native fishes are adapted to spawn in warm-water conditions (>20°C). These cold-water temperatures limit the potential for native fish to spawn below the dam. These temperature effects persist as far downstream as Farmington. Spawning of Colorado pikeminnow or razorback sucker is unlikely to occur above the Animas River because of these temperatures and the onset of suitable temperatures at Shiprock (125 km downstream) is delayed by about 2 weeks relative to what would occur without the dam (USFWS 2006). Development time of eggs and larval Colorado pikeminnow and razorback sucker is inversely related to declining temperatures below 20°C. Colorado pikeminnow eggs are unlikely to successfully hatch at temperatures of 15°C or less, and their survival is maximized at 20°C. Growth rates of larvae are more rapid as temperatures increase above 20°C. Faster growth reduces the amount of time larvae are most susceptible to predation and increases survivorship. Delays in the time of spawning reduce the amount of time available for larvae to grow prior to the onset of winter. Additionally, cooler water temperatures reduce growth rates. These effects may combine to result in lower fitness heading into the winter months and reduced overwinter survival.

6.2.1.2.5 Fish Passage Impairment

Navajo Dam blocked all fish passage, limiting the ability of native fish to move to geographically favorable areas to support their life-history requirements according to environmental climate variability (USFWS 2002a,b). Five other diversion structures were historically identified as barriers to fish migration, occurring between Farmington and the Utah state line. They include Cudei, Hogback, PNM, APS (FCPP), and Fruitland Irrigation Canal diversions. Cudei Diversion was removed in 2001, and Hogback Diversion was modified to include a non-selective fish passage. PNM Weir was modified to include a selective fish passage facility in 2003. The FCPP Diversion can act as a fish barrier when the control gate is closed, although APS does not fully close the control-gate, and the Fruitland Irrigation Canal Diversion can block fish passage when the sluiceway is closed (Bio-West 2005). Colorado pikeminnow, razorback sucker, and other native species have been documented to move upstream past Hogback, and PNM diversions. Neither the APS Weir or Fruitland Irrigation Canal are complete barriers to fish passage, but may impede passage during parts of the year (Bio-West 2005). Pikeminnow and razorback sucker may potentially migrate from Lake Powell upstream to RM 180, near the confluence of the Animas River (USFWS 2009).

An additional passage barrier exists where the San Juan River enters Lake Powell (Schleicher and Ryden 2013). At this location, sediment deposited from the river after Lake Powell was filled. When Lake Powell is not full, this deposited sediment creates an approximately 30-foot-high waterfall , which prevents fish from moving upstream into the San Juan River. Pikeminnow and razorback sucker that pass over this waterfall cannot return to the San Juan River to contribute to the population. Additionally, larval fish could be transported from the "Mixer" (a known spawning area for Colorado pikeminnow located between RMs 129.8 and 133.4) to Lake Powell in as little as 3 days (Figure 6-1) (Dudley and Platania 2000). Surveys conducted in 2011 in the San Juan arm of Lake Powell documented both Colorado pikeminnow and razorback sucker ((Schleicher and Ryden 2013)); however, the survival of Colorado pikeminnow and razorback sucker entering Lake Powell is unknown. Larval survival is likely to be quite low because of lack of suitable habitat and an abundance of predators. Razorback sucker may be able to reproduce within the lake, but Colorado pikeminnow cannot. This barrier is not complete as the waterfall is inundated by Lake Powell during wetter periods, allowing fish access (which occurs approximately once in 10 years, on average). Razorback sucker tagged on the San Juan River have been documented in the upper Colorado River, indicating that some exchange of individuals from the San Juan to the upper Colorado through Lake Powell can occur.

6.2.1.3 Competition and Predation

Native fishes in the southwestern U.S. have been negatively impacted by the proliferation of non-native fishes, extensive water development, and anthropogenic alteration of habitats. Management agencies have identified competitive and predatory interactions with non-native fishes as a potential factor affecting the native species and the recovery of listed species in the upper Colorado watershed, and both the Upper Colorado River Recovery Program and the SJRRIP have established removal projects to control non-native fish species.

At least 14 species of non-native fish occur in the San Juan River (Gerig and Hines 2013; Duran et al. 2013). Channel catfish have been identified as a significant predator in the San Juan River and may also result in a choking hazard for Colorado pikeminnow that attempt to feed upon them. Red shiner have also been identified as a predator on larval fish (USFWS 2002a,b; Gerig and Hines 2013; Duran et al. 2013). Common carp were previously identified as a significant threat (USFWS 2002a,b). The non-native fish control program on the San Juan River targets large-bodied native fish. This program began in 1998, with more intensive efforts beginning in 2001 (Duran et al. 2013; Gerig and Hines 2013). These efforts have substantially reduced the population of carp throughout the river, and the population of adult channel catfish above Shiprock, although the population increased in 2012 between Hogback Diversion and Shiprock (Duran et al. 2013). The population of adult channel catfish has not declined markedly between Shiprock and Mexican Hat (Duran et al. 2013) or downstream of Mexican Hat (Gerig and Hines 2013), although the age structure appears to be shifting towards smaller channel catfish. There is also an upward trend in both abundance and longitudinal distribution between both flannelmouth sucker and bluehead sucker that corresponds with the intensive non-native fish removal efforts that began in 2001. The Proposed Action may affect this factor.

6.2.1.4 Disease and Parasites

In addition to the threats posed by non-native fish with regard to competition and predation, non-native fish may also serve as vectors for disease and parasites (USFWS 2002a,b). Predation and disease are not considered to be a significant threat to Colorado pikeminnow (USFWS 2011a) and razorback sucker (USFWS 2012c). The presence of a large number of non-native fish has the potential to contribute to such issues in the future. This threat is partly offset by the non-native fish control programs (USFWS 2011a, 2012c). The Proposed Action may affect this factor.

6.2.1.5 Adequacy of Existing Regulatory Mechanisms

Implementation of a regulatory mechanism is necessary for recovery of Colorado pikeminnow and razorback sucker (USFWS 2011a, 2012c). Once these species are delisted and removed from the protections afforded by the ESA, they will continue to receive protection under the NEPA, Clean Water Act, Organic Act, and Fish and Wildlife Coordination Act.

The 5-year reviews for the two species (USFWS 2011a, 2012c) identified the need for conservation plans and agreements to provide reasonable assurances that recovered Colorado pikeminnow populations will be maintained. The Proposed Action will not affect this factor.

6.2.1.6 Other Natural or Man-Made Factors

The 5-year reviews for the two species (USFWS 2011a, 2012c) identify potential contaminants, including pesticides and other pollutants as potentially affecting Colorado pikeminnow and razorback sucker (USFWS 2011a, 2012c). However, the role of these contaminants in suppressing their populations is not well understood. The potential spill of petroleum products and the Atlas Mines tailings pile are identified as specific threats to both species. Hybridization with other suckers was identified as a specific threat to razorback sucker, although the degree to which hybridization occurs is unknown. The Proposed Action will not affect either of these situations. Selenium is mentioned as a specific threat for both species and mercury is specified as a potential threat to razorback sucker (USFWS 2012c), and the 5-year review recommended that the effects of mercury on Colorado pikeminnow be investigated (USFWS 2011a). The Proposed Action may affect these parameters, as discussed below.

6.2.1.7 Air Quality

In December 2013, FCPP notified EPA of its intent to proceed with BART Option 1.

To comply with BART Option 1, APS decided to take the following actions:

1. Shut down Units 1, 2, and 3.
2. Install SCR equipment on Units 4 and 5.

Each of these actions was described in detail in Section 2.5.2.2.1. These actions will substantially reduce emissions from FCPP as detailed in Table 2-9.

6.2.1.8 Water Quality

Water quality is of concern in the San Juan River Basin with many water bodies, including the San Juan River, being impaired for one or more factors, including metals, sediment, salinity, temperature, and dissolved oxygen (USFWS 2006). Land uses within the basin contribute these water quality concerns by contributing metals, salts, PAHs, and pesticides to the San Juan River and its tributaries. Thomas et al. (1998, as reported in USFWS 2006) found that the concentrations of most potentially toxic elements analyzed from the San Juan River drainage were not high enough to be of concern for fish, wildlife, or humans, with the exception of selenium. Simpson and Lusk (1999) and Lusk (2010) identified mercury and selenium as contaminants of particular concern, because of their concentrations in fish tissues within the system.

6.2.1.8.1 Mercury

Mercury is a naturally occurring element. It can be found in soils and the atmosphere, as well as water bodies. Atmospheric transport and deposition is an important mechanism for the global deposition of mercury (EPRI 2014), as it can be transported over large distances from its source regions and across continents. It is considered a global pollutant. Atmospheric mercury is primarily inorganic and is not biologically available. However, once this mercury is deposited to the earth, it can be converted into a biologically available form, methylmercury (MeHg), through a process known as methylation. MeHg bioaccumulates in food chains, and particularly in aquatic food chains, meaning that organisms exposed to MeHg in their food can build up concentrations that are many time higher than the ambient concentrations in the environment.

Inorganic atmospheric mercury (Hg) occurs in three forms:

- Elemental mercury vapor (Hg(0)), also referred to as gaseous elemental mercury (GEM)
- Gaseous divalent mercury, Hg(II), also referred to as reactive gaseous mercury (RGM) or gaseous oxidized mercury (GOM)
- Particulate mercury, Hg(p), also referred to as particle bound mercury (PBM); PBM can be directly emitted or can form when RGM adsorbs on atmospheric particulate matter.

In the global atmosphere, Hg(0) accounts for more than 90 percent of total mercury, on average, while both RGM and PBM typically account for less than 5 percent (EPRI 2014). The reactive form of mercury is often deposited to land or water surfaces much closer to their sources due to its chemical reactivity and high water solubility. PBM is transported and deposited at intermediate distances depending on aerosol diameter or mass. Within the atmosphere, numerous physical and chemical transformations of mercury can occur depending on many factors.

The various forms of mercury have very different physical and chemical characteristics, resulting in large differences in their removal rates from the atmosphere, and consequently, in their atmospheric lifetimes (EPRI 2014). GEM has a lifetime of the order several months to more than a year because of its low reactivity, low water solubility, and slow deposition rate. Thus, it is considered a global pollutant since it is transported over long distances. On the other hand, the lifetimes of both RGM and PBM are much smaller, ranging from a few hours to days, because they are removed efficiently by dry and wet deposition, particularly RGM. Thus, mercury is a pollutant at all scales ranging from global to local.

Mercury is emitted by both natural and anthropogenic sources. Natural sources of mercury represent about 70 percent of the global mercury emission budget. Natural sources include volcanoes, geothermal sources, and exposed naturally mercury-enriched geological formations. These sources may also include re-emission of historically deposited mercury as a result of evasion from the surface back into the atmosphere, fires, meteorological conditions, as well as changes in land use and biomass burning. Anthropogenic sources of mercury include burning of fossil fuels, incinerators, mining activities, metal refining, and chemical production facilities.

In 2001, EPA reported that 711,553 g (~1,569 pounds) were deposited in the San Juan River Basin. Sources of this mercury deposition in the basin were attributed to the global pool of mercury (95.8 percent), followed by “other sources” (1.8 percent), San Juan Generating Station (1.8 percent), FCPP (1.0 percent), and Mexico (0.6 percent).

Aquatic systems receive mercury by direct deposition from the atmosphere and from overland transport from within the watershed (EPA 1997b). Mercury primarily enters aquatic systems in an inorganic form where it can adsorb to suspended solids and settle to the bottom (EPA 1997b). It can also be photo reduced in the upper few centimeters of the water’s surface and then evade to the atmosphere. RGM at the sediment water boundary can be transformed into MeHg by sulfate-reducing bacteria, but this process can also go the other direction, depending on site-specific conditions. The most important areas for methylation are anoxic areas of the aquatic environment, such as wetlands or poorly mixed areas. The vast majority of mercury in fish tissue is in the form of MeHg (EPA 1997b). Rates of methylation processes and bioaccumulation typically vary and depend on many factors.

6.2.1.8.2 Selenium

Selenium, a trace element, is a natural component of coal and soils in the area and can be released to the environment by the irrigation of selenium-rich soils and the burning of coal in power plants with subsequent emissions to air and deposition to land and surface water. Contributions from anthropogenic sources have increased with the increases of world population, energy demand, and expansion of irrigated agriculture. Selenium, abundant in western soils, enters surface waters through erosion, leaching, and runoff. Abell (1994), Blanchard et al. (1993), and Thomas et al. (1997, 1998) have reported selenium sources, both anthropogenic and natural, in the San Juan River. Selenium, although required in the diet of fish at very low concentrations (<0.5 microgram per gram [μg/g] on a dry weight [DW] basis), is toxic at higher levels (>3 μg/g), and may be adversely affecting endangered fish in the upper Colorado River Basin (Hamilton 1999; Hamilton et al. 2005). Excess dietary selenium causes elevated selenium concentrations to be deposited into developing eggs, particularly the yolk (Buhl and Hamilton 2000; Lemly 2002). If concentrations in the egg are sufficiently high, developing proteins and enzymes become dysfunctional or result in oxidative stress, conditions that may lead to embryo mortality, deformed embryos, or embryos that may be at higher risk for mortality (Lemly 2002).

Thomas et al. (1998) reported that selenium concentrations in algae, odonates (dragonflies and damselflies), and western mosquitofish (*Gambusia affinis*) collected from aquatic habitats underlain by Cretaceous soils were significantly greater than in those collected from similar habitats underlain by non-Cretaceous soils. Median selenium concentrations were less than 2 μg/g DW for plant samples, less than 7 μg/g DW for invertebrate samples, and less than 6 μg/g DW for whole-fish samples collected from aquatic habitats underlain by non-Cretaceous soils. Similar samples collected from aquatic habitats underlain by Cretaceous soils contained median selenium concentrations 2 to 5 times greater. Blanchard et al. (1993) and Thomas et al. (1997) reported selenium concentrations in biota from aquatic habitats away from the river mainstem including biota collected from irrigation drains and ponds, which had much higher selenium concentrations in plants (20 μg/g DW), in invertebrates (32.5 μg/g DW), and in whole fish (41.7 μg/g DW) than those found in the mainstem.

Simpson and Lusk (1999) reported on selenium concentrations in biota collected from the San Juan River mainstem (only) using data from Thomas et al. (1997, 1998) and others (Blanchard et al. 1993; Wilson et al. 1995). Effects have been documented on fish and wildlife reproduction and survival in laboratory and other field studies associated with various selenium levels in the biota; high concentrations have been detected in biota from some locations within the basin that exceed thresholds of effect (Blanchard et al. 1993; Wilson et al. 1995; Thomas et al. 1998). Selenium concentrations can be elevated in areas where irrigation occurs on soils that are derived from or overlie Upper Cretaceous marine sediments. Thomas et al. (1998) found that water samples from USDI project irrigation-drainage sites developed on Cretaceous soils contained a mean selenium concentration about 10 times greater than those in samples from their project sites developed on non-Cretaceous soils. Percolation of irrigation water through these soils and sediments leaches selenium into receiving waters. Other sources of selenium likely include power plant fly ash and oil refineries in the basin (Abell 1994). Water depletions, by reducing dilution effects, can increase the concentrations of selenium and other contaminants in water, sediments, and biota (Osmundson et al. 2000).

Some tributaries to the San Juan River carry higher selenium concentrations than found in the mainstem of the river (Thomas et al. 1998). Increased selenium concentrations may also result from the introduction of groundwater to the mainstem of the river along its course (Keller-Bliesner Engineering and Ecosystems Research Institute 1999). Although these levels are diluted by the San Juan River flow, the net effect is a gradual accumulation of the element in the river as it travels downstream. For example, selenium concentrations in water samples collected from the mainstem of the San Juan River exhibited a general increase in maximum recorded values with distance downstream from Archuleta, New Mexico, to Bluff, Utah (<1 microgram per liter [μg/L] to 4 μg/L) (Wilson et al. 1995). The safe level of selenium concentrations for protection of fish and wildlife in water is considered to be <2 μg/L, and chronically toxic levels are considered to be >2.7 µg/L (Lemly 1993; Maier and Knight 1994; Wilson et al. 1995). Dietary selenium is the primary source for selenium in fish (Lemly 1993). Thus, sediment and biotic analyses are necessary to further elucidate the risk of selenium in water to fish and wildlife.

Estimations of selenium concentrations in the San Juan River include the contribution of the Navajo Indian Irrigation Project (NIIP). The NIIP eventually will irrigate 110,630 acres of Navajo Nation farmlands in San Juan County, New Mexico. NIIP's development includes 11 agricultural blocks of approximately 10,000 acres each. Irrigation water is transported from the Navajo Reservoir to the NIIP through a series of tunnels, siphons, open concrete-lined canals, and pipelines. Eight blocks were scheduled to be completed and in operation by 2002, with the remaining 3 blocks to be developed in the future. Irrigation return flows from the NIIP project would result in increased selenium concentrations in the San Juan River. The NIIP would not result in increased mercury concentrations in the river. The NIIP estimated an increase in selenium load of 621 pounds per year at completion of the entire project (Keller-Bliesner Engineering and Ecosystems Research Institute 1999) in addition to the contribution as of 1999. As the NIIP has not been fully completed, the total NIIP selenium contribution that may be expected in the future is not reflected in the current water quality data, but has been included as part of the baseline for purposes of evaluating NIIP impacts.

Quartarone and Young (1995) suggested that irrigation and pollution were contributing factors to Colorado pikeminnow and razorback sucker population declines, and Hamilton (1999) hypothesized that historic selenium contamination of the Upper and Lower Colorado River basins contributed to the decline of these endangered fish by affecting their overall reproductive success. However, because riverine systems are open systems where concentrations can vary considerably over time in relation to flow, and because results from the 7-year research period were inconclusive, selenium concentrations were not seen as a limiting factor to native fishes in the San Juan River (Holden 2000). However, as recovery of Colorado pikeminnow and razorback sucker proceeds, research and monitoring will need to further address this issue. These fish can live over 40 years (USFWS 2002a), increasing their frequency of exposure to both dietary and water-borne selenium. In addition, they often stage at tributary mouths such as the Mancos River before spawning, increasing their exposure to elevated levels of dietary selenium (Wilson et al. 1995).

6.2.1.8.3 Atmospheric Emissions

The Deposition Area ERA found that fish in Morgan Lake are likely at risk to adverse effects from maximum baseline COPEC concentrations as measured in fish tissue or surface water. Deposition Area ERA results for Morgan Lake fish are summarized in Table 6-1.

Table 6-1 ERA Results for Fish Exposures to Morgan Lake Baseline Conditions

COPEC	Tissue Concentration (mg/kg ww)	Hazard Quotient
Chromium	1.1	8.9
Nickel	0.57	29
Selenium	3.5	6.5 – 190
Zinc	26	6.7

Note: The HQs for selenium reflect the range of HQs for early life -stage fish to adult fish.

Although barium was not measured in fish tissue, its dissolved phase surface-water concentration of 140 µg/L corresponds to an HQ of 36, meaning that elevated Morgan Lake surface-water concentrations of barium may pose a risk of adverse effects to fish in Morgan Lake.

Colorado pikeminnow and razorback sucker are not expected to utilize Morgan Lake, as it does not provide suitable habitat for either species. However, the assessment of Morgan Lake was intended to be representative of other lakes within the Action Area (AECOM 2013b). Three nearby ponds (East Avocet, West Avocet, and Hidden ponds), collectively referred to as the NAPI ponds, managed by the Navajo Nation through the NNDFW, are used to rear razorback suckers for ongoing augmentation and recovery efforts under the SJRRIP. Because razorback sucker raised in the NAPI ponds do not reach the adult life stage, the higher selenium HQ of 190 for adult fish, shown in Table 6-1, is not relevant. If razorback suckers in the NAPI ponds experience the same exposures as fish in Morgan Lake then, based on the elevated HQs shown in Table 6-1, (8.9 for chromium, 29 for nickel, 6.5 for selenium, and 6.7 for zinc), razorback sucker in the NAPI ponds would likely be at significant risk to adverse effects from baseline exposures. However, razorback suckers at NAPI ponds are fed an artificial diet and, therefore, would not experience adverse dietary exposures from baseline conditions. Therefore, it is reasonable to conclude that razorback sucker in NAPI ponds are not at risk to adverse effects from baseline COPEC concentrations.

The ERAs also found that fish in the San Juan River are likely at risk of adverse effects from maximum baseline COPEC concentrations as measured in fish tissue or surface water. ERA results for San Juan River fish are summarized in Table 6-2.

Table 6-2 ERA Results for Fish Exposures to San Juan River Baseline Conditions

COPEC	Tissue Concentration (mg/kg ww)	Hazard Quotient
Chromium	2.0	15
Copper	3.0	1.8
Lead	1.7	0.65 – 5.0
Mercury	0.22 - 2.7	0.024 – 11
Selenium	1.5 – 3.9	1.5 – 220
Zinc	70	0.65 – 5.0

Note: The HQs for chromium, copper, and zinc reflect potential impacts to early life-stage fish in the San Juan River within the Deposition Area; the HQ for lead reflects potential impacts to adult fish in the San Juan River within the Deposition Area. The HQs for mercury and selenium reflect potential impacts to early life-stage and adult fish throughout the San Juan River from within the Deposition Area to the San Juan River arm of Lake Powell.

Several COPECs not measured in fish have elevated San Juan River surface-water concentrations that correspond to HQs exceeding 1. Aluminum, barium, and manganese were found to have dissolved phase surface-water concentrations of 9,000, 200, and 400 µg/L, which correspond to HQs of 100, 50, and 3.3, respectively.

While the ERAs did not evaluate species-specific baseline risks to fish, if the reported risks to surrogate fish are assumed to be representative of Colorado pikeminnow and razorback sucker, then the results show that these federally listed species may be at significant risk of adverse effects.

Although the ERAs found that aluminum, barium, chromium, copper, lead, manganese, mercury, selenium, and zinc all have the potential to adversely impact Colorado pikeminnow and razorback sucker, mercury and selenium are the two COPECs that have historically been considered the most significant chemical risk factors for these species (Simpson and Lusk 1999). The focus on mercury and selenium is due largely to their transformation from inorganic to organic species in aquatic systems resulting in an extremely high bioaccumulation and biomagnification potential.[18] The MeHg bioaccumulation factor (BAF) of 335,000 used

[18] The BAF used in the ERAs for total mercury was 3,530. For methylmercury, BAFs of 66,200 and 335,000 were used for Trophic Levels 3 and 4 fish, respectively. For selenium, BAFs of 485 and 1,692 were used for Trophic Levels 3 and 4 fish, respectively.

in the ERAs for Trophic Level 4 fish means that the mercury body burden in a top predator fish like Colorado pikeminnow would be 335,000 times higher than the MeHg concentration in the water.

The EPA (1998) methodology for estimating ecological risks as HQs infers potential risk to individuals, not populations. While the magnitude of the HQ does not directly correspond to the magnitude of effect to individuals, it provides some indication of the likelihood of adverse effects to individuals. Because the survival, growth, development, and reproduction of individuals can directly affect the population, it may be inferred that the magnitude of the HQ may also relate to the likelihood of population-level effects. The highest mercury HQ of 11 for San Juan River fish is based on the maximum detected baseline fish mercury body burden of 0.27 mg/kg ww and a critical body residue (CBR) of 0.025 mg/kg ww (AECOM 2013b).

The mercury CBR of 0.025 mg/kg ww was established in the Deposition Area ERA by application of an extrapolation factor of 10 to the LOEC of 0.25 mg/kg ww as reported by Freidman et al. (1996). In this study, three exposure groups of 22 juvenile walleye were exposed to a diet of catfish meat containing either 0 (control), 0.1 or 1.0 mg/kg MeHg over a period of six months. At the end of the 6-month exposure period, whole body tissue concentrations in the control, 0.1 and 1.0 mg/kg dietary exposure groups were 0.06, 0.25, and 2.37 mg/kg ww, respectively. The authors reported significantly ($p<0.05$) lower gonadosomatic indices for mercury-exposed male walleye in both exposure groups, as compared to controls.

Histological examination revealed testicular multifocal cell atrophy in both exposure groups. Overt histological effects were not observed in control group walleye (Friedman et al. 1996). It is noted that the CBR of 0.025 mg/kg ww established in the Deposition Area ERA is intended to reflect the highest NOEC that is less than the lowest LOEC, yet the mercury body burden in the control group in the Friedman et al. (1996) study was 0.06 mg/kg ww implying that the 10-fold LOEC to NOEC extrapolation factor in the Deposition Area ERA was an overestimate. The Friedman et al. (1996) control group mercury body burden of 0.06 mg/kg ww may be a more appropriate NOEC for this study. The Friedman et al. (1996) study did not provide any information from which to infer the percent of individuals adversely affected within the sample population of 22 individuals per exposure group. Thus, no inference can be made regarding potential population-level effects from this study (or CBR) alone.

Beckvar et al. (2005) reviewed eight primary studies of juvenile and adult fish and two primary studies of early life stage (ELS - eggs, larvae, fry) that reported both adverse effects and whole body mercury concentrations. Based on their review of these studies, the authors derived a threshold effects level (TEL) of 0.2 mg/kg ww for juvenile and adult fish and a TEL of 0.02 mg/kg ww for ELS fish based on growth, development, reproduction, and behavior. The TEL represents a tissue body burden below which adverse effects are expected to be rare (Beckvar et al. 2005). To put the San Juan River fish mercury body burden in context with the TEL, the San Juan River ERA reported average (e.g., 95% UCL) predicted baseline fish body burden mercury concentrations for Colorado pikeminnow ranging from 0.045 to 0.31 mg/kg ww depending on the particular reach of the river, with the highest body burdens in the lower two reaches of the river (Area 3 and San Juan River arm of Lake Powell). As shown in Table 6-3, this comparison shows that the average predicted Colorado pikeminnow baseline mercury body burden in the lower two reaches of the San Juan River (0.31 mg/kg ww) is about 55 and 1,450 percent higher than the Beckvar et al. (2005) threshold above which adverse effects on growth, development, reproduction, and behavior may occur for adult/juvenile and ELS fish, respectively, while those in the upper two reaches were 77 percent below the Beckvar et al. (2005) threshold for adult/juvenile fish and 125 percent (Area 1) to 335 percent (Area 2) higher than the threshold for ELS fish. These measures of percent increase above TELs do not directly infer corresponding increased impacts to Colorado pikeminnow populations as the TEL was not derived based on numbers of fish affected from the study populations. Rather, Beckvar et al. (2005) derived the TELs by statistical averaging of fish tissue mercury NOECs and LOECs taken from 10 studies. Because Colorado pikeminnow are known to undertake long distance migrations, it is assumed that individuals may use the entire accessible extent of the San Juan River over the course of their lives and could be found in any part of the river, depending on season. Fish in the San Juan Arm of Lake Powell have limited ability to connect with the populations in the San Juan River, due to the falls at the downstream end of the river. Thus, fish in the San Juan Arm are only expected to enter the breeding population in the San Juan River about 1 year in 10, when Lake Powell's elevation increases enough to inundate the falls and provide upstream passage.

Table 6-3 Percent Exceedance of 95% UCL Baseline San Juan River Fish Tissue Mercury Concentrations above Beckvar et al. (2006) TELs

Reach of the San Juan River	Tissue Concentration (mg/kg ww)	Percent Exceedance Above Juvenile/Adult TEL of 0.2 mg/kg ww	Percent Exceedance Above ELSTEL of 0.02 mg/kg ww
Area 1	0.045	Tissue Concentration < TEL	125%
Area 2	0.087	Tissue Concentration < TEL	335%
Area 3	0.31	55%	1,450%
San Juan River Arm of Lake Powell	0.31	55%	1,450%

Note: The fish tissue concentrations presented in Table 6-3 are for forage fish collected from the San Juan River as reported in Simpson and Lusk (1999). As such, these 95% UCL concentrations may under-estimate baseline fish tissue mercury concentrations in higher trophic level fish such as Colorado pikeminnow.

A follow-up study by the same researchers used a dose-response approach that combined multiple endpoints related to survival, growth, and reproduction separately for juvenile/adult fish and ELS fish (Dillon et al. 2010). From the dose-response relationships, these authors reported control-adjusted estimates of percent injury associated with mercury body burdens. Percent injury was defined by the authors as a composite dose-response metric combining a range of biological responses assumed to be related to lethality including mortality, severe developmental abnormalities, failure of fry to hatch, and failure of adult fish to spawn. At a mercury body burden of 0.2 mg/kg ww, the authors reported that 5.5 and 33 percent of juvenile/adult fish and ELS fish, respectively, would be expected to exhibit injury, respectively. At a mercury body burden of 0.3 mg/kg ww, the authors reported percent injuries of 8.2 and 42.5 percent for juvenile/adult fish and ELS fish, respectively. These body burden values are roughly similar to the maximum body burdens under current conditions in the San Juan River ERA of 0.22 to 0.31 mg/kg ww. Since these estimates were taken directly from composite dose-response relationship, they provide improved translation to population-level effects compared to the TELs reported by Beckvar et al. (2005).

The results of the ERAs interpreted in the context of underlying fish mercury toxicity studies clearly show that the mercury concentrations measured or predicted to be present in San Juan River fish, including Colorado pikeminnow, are at levels that would likely result in adverse effects at the population level. However, because of the numerous uncertainties associated with extrapolation from other species (e.g., walleye, fathead minnow, mummichog, brook trout) to those species present in the San Juan River (e.g., Colorado pikeminnow) and from laboratory test conditions to San Juan River field conditions, an accurate prediction of impacts to Colorado pikeminnow populations from baseline mercury body burdens is difficult at best. Nevertheless, the available data on San Juan River mercury body burdens and mercury toxicity in fish clearly shows a strong likelihood that baseline mercury body burdens are at levels that would result in impacts to Colorado pikeminnow populations in the San Juan River.

6.2.1.8.4 Behavioral Effects of Mercury

Numerous studies have reported on the behavioral effects of mercury exposure to fish. A study by Webber and Haines (2003) provides quantitative estimates of behavioral effects in golden shiner exposed to dietary MeHg at concentrations of 0.012 (control), 0.455, and 0.959 mg/kg mercury under standard laboratory conditions for 90 days. At the end of the exposure period, whole body fish tissue mercury concentrations were 0.041 (control), 0.230, and 0.536 mg/kg ww. No mortality or effects on growth were observed at any dose. Predator-avoidance behavior to a model belted kingfisher was evaluated for multiple behavioral responses. The authors reported statistically significant ($p<0.05$) behavioral impairment for shoal vertical dispersal, time to return to pre-exposure activity, and greater shoal area after return to pre-exposure activity levels for fish with 0.536 mg/kg ww whole body fish tissue mercury concentrations. The authors referred to these responses as hyperactive responses, which can make the prey more easily detected and more easily fatigued. For this study (Webber and Haines), this concentration represents a LOEC and the 0.230 mg/kg ww whole body fish tissue mercury concentration represents a NOEC. Hyperactive behavioral responses from mercury exposure to fish have also been observed in rainbow trout and largemouth bass (Hartmann 1978; Morgan 1979). Fjeld et al. (1998) reported impaired feeding efficiencies and reduced competitive abilities in 13-day old graylings fed a diet containing MeHg. The resulting whole body tissue concentrations ranged from 0.09 to 3.8 mg/kg ww for the lowest and highest exposure groups. The authors reported statistically significant ($p<0.05$) behavioral effects at concentrations of 0.27 mg/kg ww and higher indicating that this concentration would represent a LOEC and the next lower concentration of 0.09 mg/kg ww would be a NOEC.

The ERAs utilized NOEC-based CBRs of 0.025 and 0.8 mg/kg ww for reproductive effects, impaired growth, and survival in ELS and adult fish, respectively. From the behavioral studies discussed above, NOEC-based CBRs would be 0.09 and 0.230 mg/kg ww for ELS and adult fish, respectively. Given that the ESL CBR used in the ERAs was actually based on a LOEL of 0.25 mg/kg ww extrapolated to a NOEC of 0.025 mg/kg ww, this comparison suggests that behavioral effects in ELS fish likely occur at about the same exposure levels as other population-level effects such as growth and survival. For adult fish behavioral effects may occur at lower concentrations than the CBR used in the ERAs. From a population effects perspective, reproduction, growth, and survival are endpoints that can easily be measured in the laboratory and that can be translated to population-level effects using exposure-response relationships such as those reported by Dillon et al. (2010). These types of direct effects are much more easily quantifiable than indirect effects, such as behavioral effects, which can also be detrimental to the population through impairment of such activities as predator-avoidance, feeding, spawn cueing, and ability to locate nursery or spawning areas. Therefore, the HQs as reported in the ERAs, which are based on NOEL-based CBRs for standard endpoints of reproduction, growth, and survival, are likely protective of ELS fish, but may not provide a comparable level of protection for adult fish. Therefore, the HQs reported for Colorado pikeminnow exposure to mercury may be under-estimated with respect to population-level effects. However, its magnitude cannot be predicted from the available data.

6.2.1.8.5 Selenium Toxicity in Fish

Selenium has been shown to elicit a wide range of adverse effects in fish including mortality, reproductive impairment, effects on growth, and developmental and teratogenic effects including edema and finfold, craniofacial, and skeletal deformities (Hamilton 2004; Holm et al. 2005). For the assessment of risk to fish from exposure to selenium, the ERAs utilized NOEC-based CBRs of 0.54 mg/kg ww for ELS fish (based on impaired growth in Chinook salmon) and 0.018 mg/kg ww for adult fish (based on impaired growth in fathead minnow) from studies conducted by Hamilton et al. (1990) and Bertram and Brooks (1986), respectively. Because a NOEC lower than the lowest LOEC of 0.18 mg/kg ww was not identified, AECOM (2013b) extrapolated the LOEC to a NOEC of 0.018 mg/kg ww by application of a factor of 0.1.

In their evaluation of selenium exposure to Chinook salmon in the San Joaquin River, Beckon and Maurer (2008) noted that selenium toxicity in fish is represented by a biphasic dose response where selenium exposure at low doses is beneficial and selenium exposure at high doses is toxic. By application of a biphasic regression model to the selenium toxicity (survival) data reported by Hamilton et al. (1990), Beckon and Maurer (2008) estimated the optimal beneficial whole body tissue selenium concentration to be about 1 mg/kg dw, which corresponds to about 0.2 mg/kg ww based on the EPA (2010) recommendation to assume an average fish tissue moisture content of 80 percent to convert dry weight fish tissue concentrations to wet weight tissue concentrations and vice versa. The apparent discrepancy between the optimal whole body tissue selenium concentration of 0.2 mg/kg ww reported by Beckon and

Maurer (2008) and a LOEC whole body tissue selenium concentration of 0.18 mg/kg ww reported by Bertram and Brooks (1986) could reflect differences in species sensitivity between Chinook salmon and fathead minnow, but could also reflect variability or differences in experimental procedures, uncertainty in the dose-response model, or that there is simply very little margin of safety between the optimal beneficial concentration and the lowest effects concentration.

In their evaluation of available fish selenium toxicity studies with corresponding whole body tissue concentrations, AECOM (2013b,c) did not consider the Holm et al. (2005) study on developmental effects, apparently because the exposure was reported for wet weight egg selenium concentrations, not whole body tissue selenium concentrations. In this study, the authors reported adverse developmental effects (edema and finfold, craniofacial, and skeletal deformities) in larval salmonids exhibiting elevated selenium concentrations in eggs. Interestingly, neither mortality nor effects on fertilization were observed in this study, a finding that the authors report to be consistent with other studies with bluegills, cutthroat trout, perch, and fathead minnows reporting on developmental effects. Holm et al. (2005) hypothesized that because selenium is incorporated in the egg yolk, and the egg yolk is rapidly consumed just before hatch, these teratogenic effects are not manifested until hatch. Because these effects have been observed in the absence of embryo mortality or adverse effects on fertilization, they likely occur at lower exposures than would result in mortality or reproductive impairment. Based on dose-response modeling for rainbow trout, Holm et al. (2005) reported that egg selenium concentrations of 8 to 10 mg/kg ww could result in 15 percent skeletal deformities, craniofacial defects, and edema, and that at slightly higher egg selenium concentrations of 12 mg/kg ww, 30, 40, and 70 percent of the population may effected by these effects, respectively.

While the Holm et al. (2005) egg selenium concentrations are not directly comparable to the CBR whole body selenium concentrations used in the ERAs, egg selenium concentrations reported by Holm et al. (2005) were about two- to seven-fold higher than muscle selenium concentrations. If it is assumed that fish whole body selenium concentrations are equivalent to fish muscle selenium concentrations, and that egg concentrations are seven-fold higher than whole body concentrations, then the 8 to 10 mg/kg ww egg selenium concentration that could result in 15 percent teratogenic effects would correspond to about 1 to 2 mg/kg ww whole body selenium concentrations affecting 15 percent of the population. While this range of whole body selenium concentrations is higher than the CBBs used it the ERAs, the findings of the Holm et al. (2005) study suggest that teratogenic effects of selenium exposure could result in substantial population-level effects at about the same levels of exposure that may result in mortality, reproductive impairment, and effects on growth to individual fish.

<u>Future Atmospheric Deposition</u>

A number of studies and international agreements have related to future mercury emissions that make future trends in global mercury emissions unclear. While concern exists that global mercury emissions will continue to increase over the next 25 years (with China being a particular concern), a recent United Nations report showed that global mercury emissions to the atmosphere were relatively stable between 1990 and 2005, with increased emissions in Asia offset by decreased emissions in Europe and North America (UNEP 2013a). In late 2011, China released new national emissions standards to control SO_2, NO_X, and particulate emissions, which should result in mercury emissions reduction if successfully implemented (CCICED 2011). On October 10, 2013, China joined 91 other countries in signing the Minamata Convention on Mercury, also known at the Global Mercury Treaty, which includes provisions for controlling mercury releases from large-scale industrial plants including coal-fired power plants (UNEP 2013b). Some analysis supports a conclusion that increased mercury emissions from China are now offsetting more recent reductions in North America and Europe (UNEP 2013a).

San Juan River ERA Scenario 8 results reflect exposures associated with future regional sources of mercury and selenium and global (China) sources of mercury[19] in addition to baseline conditions (past and present) and future FCPP emissions associated with the Proposed Action. The San Juan River ERA shows that cumulative mercury and selenium concentrations are likely to adversely affect Colorado pikeminnow and razorback sucker in the 4 ERA modeling reaches of the San Juan River downstream into the San Juan River arm of Lake Powell (Table 6-4). Comparison of effects associated with baseline conditions, emissions under the Proposed Action, and future emissions from other sources indicates that the largest components of mercury and selenium in cumulative conditions are baseline conditions, followed by future emissions from sources other than the Proposed Action (Tables 6-4 and 7-2. The cumulative mercury and selenium concentrations in the Action Area over the Project life are expected to increase, which would increase the likelihood of adverse effects on Colorado pikeminnow and razorback sucker.

Table 6-4 Species-Specific ERA Results for San Juan River based on San Juan River ERA Scenario 8 and contribution from Proposed Action

COPEC/ Species	Cumulative Effects Tissue Concentration (mg/kg ww)	Cumulative Effects Hazard Quotient
Mercury/FF	0.10 - 0.21	4.1 - 8.4
Mercury/CPM1	0.19 - 0.59	7.6 - 24
Mercury/CPM2	0.45 - 1.2	18 - 46
Mercury/RS1	0.11 - 0.19	4.4 - 7.8
Mercury/RS2	0.22 - 0.35	8.7 - 14
Selenium	0.40 - 0.78	22 - 43

Note: Tissue concentrations and HQs reported in the San Juan River ERA reflect the range of concentrations across the four areas evaluated in the San Juan River.

CPM1 = Colorado pikeminnow < 400 mm
CPM2 = Colorado pikeminnow >400 mm
FF = forage fish
RS1 = razorback sucker < 400 mm
RS2 = razorback sucker >400 mm

6.2.1.9 Climate Change

Climate change over the coming decades and centuries has the potential to affect many organisms, including freshwater fish. Climate change has the potential to change precipitation patterns, including the timing, intensity, and type of precipitation received; runoff patterns based on the amount of precipitation falling as snow and when snowmelt occurs; and atmospheric temperatures, which exhibit a strong influence on water temperatures.

According to the NRC (2007), air temperature has increased by 1.4°C in the last century. The Colorado River Basin has warmed more than any other part of the U.S. Warmer air temperatures will lead to increased evaporation from Navajo Reservoir. This increase is expected to reduce water availability and

[19] The San Juan River ERA HQs are in some cases less than those reported for baseline conditions because the values presented there were based on measured concentrations from within the Action Area or its vicinity. The EPRI modeling used to provide mercury, selenium, and arsenic concentrations for the San Juan River ERA were calibrated to these measured values, but the concentrations are predicted through the deposition, fate, and transport processes incorporated into those models and, thus, result in somewhat different results.

operational flexibility, which are important elements to native fish in the river downstream. This effect would be cumulative with future water development in the basin.

Native fish in the San Juan River cannot move upstream in response to climate changes because their migration is blocked by Navajo Dam (USFWS 2002a,b), which precludes migration to more favorable upstream areas as a behavioral adaptation to changing climate conditions. However, Navajo Dam currently releases water that is colder than what would naturally be present during the summer and fall months (USFWS 2006). Thus, the temperature effect of climate change could be offset by the dam's operation.

Climate change models generally agree that the southwest will get drier in the next century, with runoff decreasing 8 to 25 percent (Seager et al. 2007), resulting in decreased water availability to meet all demands, including those of fish. This reduction in precipitation will make it increasingly challenging to meet the flow recommendations for the San Juan River, established to protect listed fish and other native fish species, especially the high-flow requirements that provide for channel maintenance and create habitat for listed fish. In the current drought, Reclamation has not been able to provide the required number of days of flow over 10,000 cfs since 2005 (Reclamation 2012). If the drier patterns predicted by the climate models are correct, it may become increasingly difficult to meet all water needs in the basin.

Runoff may also occur earlier in the year as a result of warmer temperatures. Fish are adapted to time their spawning migrations based on flow and temperature patterns, but the role of day length in this timing is unknown. If it is important, fish could miss the optimal period for spawning, as they could migrate upstream to spawn later in the year, after the most suitable conditions have passed. If day length is not an important cue, then the young fish might benefit from the longer growing season before entering their first winter, but other challenges may present themselves, such as insufficient water, inadequate habitat, or decreased food supply. These factors cannot be adequately predicted at this time.

Reduced flow levels may also exacerbate contaminant issues, as less dilution of contaminants in the river would occur. Additionally, if increased water is required for agricultural uses, it could result in increased runoff of pesticides and selenium from agricultural return flows. However, as water becomes more valuable, return flows are more likely to be recaptured and reused, rather than letting them run off into the river.

6.2.2 Southwestern Willow Flycatcher and Yellow-Billed Cuckoo

Both southwestern willow flycatcher and yellow-billed cuckoo are riparian obligates. While species-specific breeding, nesting, and migration patterns may differ, both of these species occupy similar riparian landscape features within their known ranges of the arid west, and have been documented as migrant visitors, either recently or historically, in the vicinity of the Action and Deposition areas. Given these similarities in habitat preference and that the threat factors affecting these two species are very similar, if not identical, they have been evaluated together within the Action and Deposition areas.

6.2.2.1 General Factors

Past and present federal, state, and private activities that may affect the southwest willow flycatcher and yellow-billed cuckoo within the Action Area include urbanization, agricultural conversion, irrigated agriculture, river maintenance, flood control, dam operation, and water diversions, which directly affect riparian habitats. Continued management of these anthropogenic factors may assist in reducing degradation of existing habitat and providing conditions that support existing habitats and development of new southwestern willow flycatcher and yellow-billed cuckoo habitats.

6.2.2.2 Habitat Loss or Modification to Habitat or Range

Neither of these species have been documented nesting in the Action or Deposition areas; however, suitable, although poor quality, migratory stopover habitat for southwestern flycatcher was identified within the Action and Deposition areas. This habitat is comprised of marginal riparian habitat comprised primarily of salt cedar in areas around the DFADA, scattered areas within the Pinabete Permit Area, and along the transmission corridors. Marginal migratory stopover habitat associated with the DFADA would be permanently converted to manage disposal of fly ash. Marginal migratory stopover habitat identified within the Pinabete Permit Area would remain, as the arroyos supporting this habitat would not be mined. This conversion represents a minor loss or modification to a small percentage of this species total available migratory stopover habitat. Given the marginal condition of habitats within both the DFADA and Pinabete Permit Area, it is expected that these species would be more likely to make use of adjacent rivers and drainages, which offer an abundance of more suitable migratory stopover habitats.

As described in Section 5.3.4, efforts are currently underway to restore riparian habitat in the San Juan River Basin (SJWWII 2006). These riparian restoration efforts indicate that suitable nesting and foraging habitat for southwestern willow flycatcher and yellow-billed cuckoo could develop along the San Juan River over the next 25 years. It is anticipated that habitat at Morgan Lake will continue to be managed as it has historically, with high recreation use. Because of this use, it is not anticipated that habitat for southwestern willow flycatcher or yellow-billed cuckoo will improve over time. Morgan Lake will continue to provide poor-quality stopover habitat in the future, but will not support nesting or suitable long-term foraging habitat for these species.

6.2.2.3 Disease or Predation

Project activities not expected to alter these species exposure to disease or predation.

6.2.2.4 Inadequacy of Regulatory Mechanisms

Project activities are not expected to cause changes in the adequacy of existing federal or state regulatory mechanisms associated with these two species.

6.2.2.5 Other Natural or Man-Made Factors

The Project is not expected to cause changes to these species available habitat within their breeding, migratory, or wintering ranges Habitat documented within the Action and Deposition areas represents a small percentage of these species overall migratory habitat, and would be expected to make use of use of adjacent rivers and drainages, which offer an abundance of more suitable migratory stopover habitats. The Project would not exacerbate these species exposure to factors affecting wintering range in Central and South America. Project activities would not affect other factors including pesticide use, brood parasitism, and livestock grazing.

6.2.2.6 Atmospheric Emissions

The ERAs found that southwestern willow flycatcher and yellow-billed cuckoo may be at risk to adverse effects from 95% UCL baseline metal concentrations in Morgan Lake and the San Juan River. ERA results for Morgan Lake and the San Juan River are summarized in Tables 6-5 and 6-5, respectively. The HQs reported in the table integrate environmental exposure from both sediment and water, based on the presumed diet of the representative species (willow flycatcher) of half benthic invertebrates and half aquatic invertebrates.

Table 6-5 ERA Results for Southwestern Willow Flycatcher and Yellow-Billed Cuckoo Exposure to Morgan Lake Baseline Conditions

COPEC	Sediment Concentration (mg/kg dw)	Water Concentration (mg/L)	Hazard Quotient
Chromium	7.0	0.0030	2.3
Copper	10	0.0045	2.9
Lead	8.7	0.0076	16
Methylmercury	0.0024	0.000000037	2.6
Selenium	0.35	0.0034	9.8

mg/L = milligram(s) per liter

Table 6-6 ERA Results for Southwestern Willow Flycatcher and Yellow-Billed Cuckoo Exposure to San Juan River Baseline Conditions

COPEC	Sediment Concentration (mg/kg dw)	Water Concentration (mg/L)	Hazard Quotient
Copper[1]	11	0.028	1.5
Lead[1]	24	0.020	1.5
Mercury	0.0030-0.020	0.0000070-0.00020	0.65-6.6
Selenium	0.13	0.0010- 0.0095	2.1 – 2.9

Note: ERA results for copper, lead, and methylmercury are applicable only to the San Juan River within the Deposition Area. ERA results for selenium reflect the range of baseline conditions for the San Juan River within the Deposition Area and downstream into the San Juan River arm of Lake Powell.

The ERAs were conducted under the assumption that suitable habitat for shelter, nesting, and/or foraging for southwestern willow flycatcher and yellow-billed cuckoo exists at Morgan Lake and along the San Juan River. In the ERAs, the diet of both species was assumed to be benthic invertebrates exposed to sediments and aquatic invertebrates exposed to surface water. Therefore, the baseline COPEC concentrations in sediments and surface water were used to estimate the concentrations in invertebrates and they were transferred to the birds via the food web. As discussed in Sections 6.1.3 and 6.1.4, Morgan Lake does not provide any suitable habitat for either southwestern willow flycatcher or yellow-billed cuckoo, although occasional migrants may be present for less than 2 weeks a year.

Therefore, baseline exposures to southwestern willow flycatcher or yellow-billed cuckoo at Morgan Lake are substantially lower than assumed in the Deposition Area ERA and would not include exposure during critical life stages associated with nesting (e.g., fledgling). If these occasional migrants are present less than 2 weeks per year, rather than the 52 weeks included by the ERAs, all southwestern willow flycatcher and yellow-billed cuckoo HQs would be reduced by a factor of 26 (2 weeks rather than 52 weeks), with resulting HQs of less than 1. Therefore, baseline conditions at Morgan Lake would not result in harm to either species. Management of riparian habitats at Morgan Lake is not anticipated to change in the future, so Morgan Lake is expected to continue to provide poor-quality stopover habitat in the future, but will not support nesting or suitable long-term foraging habitat for these species. Aside from the San Juan River (discussed separately below), no other areas of suitable nesting habitat were identified within the Deposition Area.

Within the riparian corridor of the San Juan River, from within the Deposition Area, and downstream into the San Juan River arm of Lake Powell potential southwestern willow flycatcher and yellow-billed cuckoo habitat is marginal at discreet locations and does not exist along most of the river. However, as discussed in Sections 6.1.3 and 6.1.4, both southwestern willow flycatcher and yellow-billed cuckoo have historically been detected on infrequent occasions along the San Juan River within the Action Area. Migrants are not likely to experience sufficient exposure to result in adverse effects, due to the short period of time they would be in the area (less than 2 weeks), rather than year-round as assumed by the ERAs), as described above with regard to Morgan Lake.

As described in Section 5.3.4, efforts are currently underway to restore riparian habitat in the San Juan River Basin (SJWWII 2006). These riparian restoration efforts indicate that suitable nesting and foraging habitat for southwestern willow flycatcher and yellow-billed cuckoo could develop along the San Juan River over the next 25 years. If nesting and breeding were to occur along the San Juan River within the Action Area in the future, then exposures during this critical life stage have the potential to result in adverse reproductive and developmental (growth) effects. Given that the TRVs used to assess risks to southwestern willow flycatcher and yellow-billed cuckoo were derived by the EPA to be protective of both reproduction and growth (see Section 4.3), it is appropriate to interpret the risk assessment results presented in Table 6-6 for the San Juan River as applicable under the assumption that these species could nest along the San Juan River within the Action Area. Therefore, baseline conditions in the San Juan River within the Action Area would be harmful to southwestern willow flycatcher and yellow-billed cuckoo, should they breed in this area.

6.2.2.6.1 Future Atmospheric Deposition

As previously described for Colorado pikeminnow and razorback sucker, other regional sources would contribute COPECs identified as being of concern in the Deposition Area ERA to the Action Area in the future. Future input of COPECs from these sources would be expected to add to the environmental COPEC concentrations already present under baseline conditions and those contributed by the FCPP, which would increase the risk of adverse ecological effects in the future. These additional future risks were not quantified in the Deposition Area ERA. The additional contributions of COPECs would be expected to contribute to the risk to southwestern willow flycatcher and yellow-billed cuckoo nesting in the Action Area. These species are not believed to nest in the Action Area currently, but suitable habitat could develop over life of the Proposed Action.

San Juan River ERA Scenario 8 results reflect exposures associated with future regional sources of mercury and selenium and global (China) sources of mercury[20] in addition to baseline conditions (past and present) and future FCPP emissions associated with the Proposed Action (Table 6-7). The San Juan River ERA shows that cumulative mercury and selenium concentrations and other COPECs are likely to adversely affect southwestern willow flycatcher and yellow-billed cuckoo along the San Juan River within the Deposition Area and downstream into the San Juan River arm of Lake Powell, should those species nest in these areas in the future. Comparison of effects associated with baseline conditions, emissions under the Proposed Action, and future emissions from other sources indicates that the largest components of mercury and selenium and other COPECs in cumulative conditions are baseline conditions, followed by future emissions from sources other than the Proposed Action (Table 6-7 and Table 7-4). The cumulative mercury and selenium concentrations in the Action Area over the life of the Proposed Action are expected to increase, which would increase the likelihood of adverse effects on southwest willow flycatcher and yellow-billed cuckoo, should they nest in the Action Area in the future. Migrants are not likely to experience sufficient exposure to result in adverse effects.

[20] The San Juan River ERA HQs are in some cases less than those reported for baseline conditions because the values presented baseline conditions were based on measured concentrations from within the Action Area or its vicinity. The EPRI modeling used to provide mercury, selenium, and arsenic concentrations for the San Juan River ERA were calibrated to these measured values, but the concentrations are predicted through the deposition, fate, and transport processes incorporated into those models and, thus, result in somewhat different results.

Table 6-7 ERA Results for Southwestern Willow Flycatcher and Yellow-Billed Cuckoo Exposure to San Juan River Cumulative Effects and the Proposed Action

COPEC	Cumulative Effects Sediment Concentration (mg/kg dw)	Cumulative Effects Water Concentration (mg/L)	Cumulative Effects HQ
Copper	11	0.028	1.5
Lead	24	0.020	1.5
Methylmercury	0.0030	0.0000070	6.6
Selenium	0.13	0.02 – 0.0095	2.1 – 2.9

Note: ERA results for copper, lead, and methylmercury are applicable only to the San Juan River within the Deposition Area. ERA results for selenium reflect the range of cumulative concentrations for the San Juan River within the Deposition Area and downstream into the San Juan River arm of Lake Powell. Because the Deposition Area ERA only evaluated future effects associated with the Proposed Action and did not consider any other future actions, it is assumed that for copper and lead, future deposition from FCPP emissions added to baseline conditions represents the minimum cumulative concentration of these COPECs.

6.2.2.7 Climate Change

The effects of climate change, as described in Section 6.2.1.9, has the potential to affect many organisms, including bird species. Climate change has the potential to change precipitation patterns, including the timing, intensity, and type of precipitation received; runoff patterns based on the amount of precipitation falling as snow and when snowmelt occurs; and atmospheric temperatures, which exhibit a strong influence on water availability, which could influence the health and abundance of riparian habitats across the region.

Southwestern willow flycatcher and yellow-billed cuckoo can move and select alternate nesting and migratory stopover habitats in response to climate changes, migration and nesting patterns would shift to more favorable riparian habitats as a behavioral adaptation to changing climate conditions.

Runoff may also occur earlier in the year as a result of warmer temperatures. Avian species are adapted to time their migrations and nesting activities based on seasonal patterns and temperature patterns. Avian species are expected to alter migration patterns, as they could migrate to suitable habitats earlier or later in the year. Similarly migrating and nesting avian species might benefit from the longer growing season before entering their first winter, but other challenges may present themselves, such as insufficient water, inadequate habitat, or decreased food supply. These factors cannot be adequately predicted at this time.

Reduced flow levels may also exacerbate contaminant issues, as less dilution of contaminants in the river would occur. Additionally, if increased water is required for agricultural uses, it could result in increased runoff of pesticides and selenium from agricultural return flows. However, as water becomes more valuable, return flows are more likely to be recaptured and reused, rather than running off into the river.

6.2.3 California Condor

Past and present federal, state, and private activities that may affect California condor within the Action Area include power lines and reclamation activities in the Action Area, although any such effects are discountable, as the Action Area is at the extreme edge of the species range. Condors occurring within the Action or Deposition areas are expected to be members of the Vermillion Cliffs "Nonessential – Experimental" population. Because condors would be expected to occur in the Deposition Area very infrequently, if ever, potential exposure to COPECs in the Action Area would be so rare as to be discountable.

6.2.3.1 Poisoning, Shooting, and Specimen Collection

Activities within the Action Area would not exacerbate California condor's exposure to these factors.

6.2.3.2 Collisions with Man-Made Structures

Continued operation of exiting distribution and transmission lines may affect individuals associated with the Vermillion Cliffs "Nonessential Experimental" population of California condor; however, these power lines are already in place and would not change as part of the Proposed Action. Impacts are minimized by current avian-safe management of these distribution and transmission lines. Operation and maintenance of power lines within the Action Area are compliant with APLIC guidelines and established wildlife management plans to minimize or eliminate risks associated with avian power line interaction. Continued compliance with APLIC guidelines and implementation of wildlife management plans will greatly reduce electrocution and collision risks to California condors.

6.2.3.3 Other Natural or Man-Made Factors

Reclamation activities associated with post-mining at the Navajo Mine will continue to be managed in such a manner to maintain the attractiveness to foraging by native wildlife and big game species. This effort includes reclamation and revegetation management strategies capable of supporting year-round use of big game, a preferred food source of California condor, although these effects are expected to be minimal as big-game usage of the reclaimed areas within the Navajo Mine is minimal.

6.2.4 Mexican Spotted Owl

6.2.4.1 General Factors

Past and present federal, state, and private activities that may affect Mexican spotted owl within the Action Area include power lines and the unauthorized use of roads and trails along the transmission line ROWs, which directly affect this species and its habitat.

6.2.4.2 Habitat Loss or Modification to Habitat or Range

Activities within the Action or Deposition areas would not directly remove or modify this species habitat or range, as none of its habitat is present within the Action Area. Potential habitat was identified adjacent to the APS transmission lines as a result of the AECOM Habitat Model (AECOM 2013d), but does not occur within the ROW.

6.2.4.3 Overutilization For Commercial, Recreational, Scientific or Educational Purposes

Activities within the Action Area would not exacerbate Mexican spotted owl's exposure to these factors.

6.2.4.4 Disease or Predation

Activities within the Action Area would not exacerbate Mexican spotted owl's exposure to these factors.

6.2.4.5 Inadequacy of Regulatory Mechanisms

Project activities are not expected to cause changes in the adequacy of existing federal or state regulatory mechanisms associated with this species.

6.2.4.6 Natural and Man-Made Factors

Continued operation of exiting distribution and transmission lines may affect Mexican spotted owl, by increasing the likelihood of directly mortality by collision or electrocution by power lines; however, these impacts are expected to be minimized by current avian-safe management of these distribution and transmission lines. Operation and maintenance of power lines within the Action Area are compliant with APLIC guidelines and established wildlife management plans to minimize or eliminate risks associated with avian power line interaction. Continued compliance with APLIC guidelines and implementation of wildlife management plans will greatly reduce electrocution and collision risks to Mexican spotted owls. The Project is not expected to exacerbate factors associated with noise, disturbance, and the presence of barred owls. Finally, factors affecting this species related to climate change are discussed below.

6.2.4.7 Atmospheric Emissions

The Deposition Area ERA evaluated the effects of past and present atmospheric emissions (baseline conditions) on Mexican spotted owl using the red-tailed hawk as a surrogate representative species with a diet comprising 100 percent small mammals from within the Deposition Area. HQs for all COPECs were less than 1 in the screening evaluation where it was assumed that exposure by incidental soil ingestion and to small mammal prey species was to maximum soil concentrations. However, as discussed in Section 6.1.6, Mexican spotted owls have not been documented in the Action or Deposition areas. Therefore, because HQs associated with baseline atmospheric emissions were less than 1 for all COPECs and because Mexican spotted is not likely to be currently present in the Action or Deposition areas, baseline conditions within the Action Area are not likely to harm Mexican spotted owl.

6.2.4.8 Climate Change

Climate change over the coming decades and centuries, as previously described, has the potential to affect many organisms, including bird species. Climate change has the potential to change precipitation patterns, including the timing, intensity, and type of precipitation received; runoff patterns based on the amount of precipitation falling as snow and when snowmelt occurs; and atmospheric temperatures, which exhibit a strong influence on water availability, which could influence the health and abundance of Mexican spotted owl habitat across its range.

These combined factors could have any number of effects on Mexican spotted owl including shifts in the distribution of the owl itself, along with major prey species and potential competitors and predators, possibly along elevational or latitudinal gradients; effects on demographic rates, such as survival and reproduction; changes in coevolved interactions, such as prey-predator relationships; direct loss of habitat due to increased fire severity, bark beetle outbreaks, and direct warming of habitats; increased population or range expansion of species that are direct competitors; and reductions in population size (USFWS 2012b).

Given that this species can move and select alternate nesting and migratory stopover habitats in response to climate changes, migration and nesting patterns would shift to more favorable habitats as a behavioral adaptation to changing climate conditions.

6.2.5 Mancos Milk-Vetch

6.2.5.1 General Factors

Factors identified as threats to Mancos milk-vetch at the time of its listing included oil development, transmission lines, roads, and inadequate existing regulations (44 FR 26568).

Most Mancos milk-vetch populations occur on Navajo Nation lands that are remote from urban areas and unlikely to be severely affected by land uses other than energy development. The entire range of Mancos milk-vetch occurs within a region of intense energy exploration and development.

Adult Mancos milk-vetch plants that are weakened by severe drought are frequently infested with spider mites, which appear to hasten the demise of large individuals (NHNM 1991; Sivinski and Knight 2001).No special-status plant species are known to occur and no suitable habitat was identified within the Navajo Mine or FCPP lease areas.

6.2.5.2 Atmospheric Emissions

The Deposition Area ERA found that maximum baseline soil conditions within Mancos milk-vetch habitat within the Deposition Area may be harmful to Mancos milk-vetch. The reported HQs and corresponding soil concentrations are presented in Table 6-6.

Table 6-6 ERA Results for Mancos Milk-Vetch Exposure to Baseline Soil Conditions

COPEC	Soil Concentration (mg/kg dw)	Hazard Quotient
Boron	8.8	18
Chromium	15	15
Vanadium	25	13

As discussed in Section 5.7, Mancos milk-vetch habitat is restricted to Point Lookout Sandstone, which is enriched in several elements including chromium and vanadium. USGS (1990) reported Point Lookout Sandstone chromium concentrations range from 66 to 2,230 mg/kg, with an average chromium concentration of 743 mg/kg (n=44). Similarly, the same study reported vanadium concentrations ranging from 2 to 2,384 mg/kg with an average vanadium concentration of 775 mg/kg (n=44). USGS (1990) did not report data for boron; however, Shacklette and Boerngen (1984) report that soil boron concentrations in the U.S. range from an average concentration of 33 mg/kg to a maximum concentration of 300 mg/kg. Comparison of these literature data to the soil concentrations used in the ERA show that soil concentrations are within the range of natural background (boron) and that Mancos milk-vetch appears to be tolerant and/or dependent upon substrate (e.g., Point Lookout Sandstone) that is enriched in certain metals. Therefore, while the ERA indicates HQs greater than 1 for some COPECs, Mancos milk-vetch appears to be adapted to, and may require, elevated metal concentrations. Therefore, it does not appear that baseline soil conditions are likely harmful to Mancos milk-vetch.

6.2.5.2.1 Future Atmospheric Deposition

As previously described for Colorado pikeminnow and razorback sucker, other regional sources would contribute COPECs identified as being of concern in the Deposition Area ERA to the Action Area in the future. Future input of COPECs from these sources would be expected to add to the environmental COPEC concentrations already present under baseline conditions and those contributed by the FCPP. This change would increase the risk of adverse ecological effects in the future. The Deposition Area ERA did not quantify these risks. The additional contributions of COPECs would be expected to contribute to the risk. However, as discussed in Section 6.2.5.2, comparison of the soil data on natural background concentrations to the soil concentrations used in the ERA shows that baseline soil concentrations are within the range of natural background and that Mancos milk-vetch appears to be tolerant and/or dependent upon substrate (e.g., Point Lookout Sandstone) that is highly enriched in certain metals. Therefore, it does not appear that cumulative COPEC concentrations are likely harmful to Mancos milk-vetch.

6.2.5.3 Energy and Mineral Development

As previously stated, the entire range of Mancos milk-vetch occurs within a region of intense oil and gas development and existing facilities are located within the species habitat (USFWS 2009, 2011c). Oil or gas well pads, pipelines, and access roads already occur within and near some Mancos milk-vetch populations, and more development in this region can be expected in the future. Small portions of the Slickrock Flats and Palmer Mesa habitats have been affected by oil and gas development. Power generation and distribution from coal-fired generating stations also affect this region with transmission lines and access roads. Mancos milk-vetch plants were parked on, run over, and possibly killed by the oil and gas development operations on the Palmer Mesa (Roth 2007). In addition to oil and gas development, roads and transmission lines are associated with existing coal-fired generating stations. Eight of the New Mexico populations are a few miles west of the San Juan Generating Station. The Sleeping Rock population was disturbed by a power line and a portion of the population was destroyed by the construction of a tower (USFWS 2009, 2011c).

6.2.5.4 Climate Change

Mancos milk-vetch population dynamics are correlated with rainfall. Long-lasting drought cycles could have a negative effect on the long-term viability of these populations. Periods of drought in the southwest are not uncommon. However, the frequency and duration of droughts may be altered by climate change. Almost certainly, this species and its habitat will be affected in some manner by climate change; the magnitude and extent of the change cannot be quantified at this time (USFWS 2009).

6.2.6 Mesa Verde Cactus

6.2.6.1 General Factors

Threats to Mesa Verde cactus were well documented when the species was listed; these threats continue to be a source of mortality. These factors include removal of plants by collectors, highway and transmission line construction, and ORV use (44 FR 62472). Ladyman (2004) noted complete loss of plants in historical sites from oil field development, a housing subdivision, livestock damage, and agriculture. In Colorado, livestock trampling was noted as the primary source of mortality in 2005 (CNAP 2005).

6.2.6.2 Atmospheric Emissions

The Deposition Area ERA found that maximum baseline soil conditions within Mesa Verde cactus habitat within the Deposition Area may be harmful to Mesa Verde cactus. The reported HQs and corresponding soil concentrations are presented in Table 6-7.

Table 6-7 ERA Results for Mesa Verde Cactus Exposure to Baseline Soil Conditions

COPEC	Soil Concentration (mg/kg dw)	Hazard Quotient
Boron	19	37
Chromium	17	17
Molybdenum	3.0	1.5
Selenium	1.7	3.3
Vanadium	35	18

As discussed in Section 5.8, Mesa Verde cactus habitat is restricted to Mancos shale and Fruitland shale formations (USFWS 1984). U.S. Department of Energy (2011) reported generalized concentrations of boron, selenium, and vanadium of 50, 2, and 100 mg/kg in unweathered Mancos shale. They did not report shale concentrations for chromium or molybdenum, but Shacklette and Boerngen (1984) report that soil chromium concentrations in the U.S. range from an average concentration of 54 mg/kg to a maximum concentration of 2,000 mg/kg and soil concentrations for molybdenum range from an average concentration of 0.97 mg/kg to a maximum concentration of 15 mg/kg. Comparison of these literature data to the soil concentrations used in the ERA show that soil concentrations are within the range of natural background (chromium and molybdenum). Mesa Verde cactus appears to be tolerant of and/or dependent on substrate (e.g., Mancos and Fruitland shales) that may be enriched in certain metals. Therefore, it does not appear that baseline soil conditions are likely harmful to Mesa Verde cactus.

6.2.6.2.1 Future Atmospheric Deposition

As previously described for Colorado pikeminnow and razorback sucker, other regional sources would contribute COPECs identified as being of concern in the Deposition Area ERA to the Action Area in the future. Future input of COPECs from these sources would be expected to add to the environmental COPEC concentrations already present under baseline conditions and those contributed by the FCPP. This change would increase the risk of adverse ecological effects in the future. These risks were not quantified in the Deposition Area ERA. The additional contributions of COPECs would be expected to contribute to the risk. However, as discussed in Section 6.2.6.2, comparison of the soil data on natural background concentrations to the soil concentrations used in the ERA shows that baseline soil concentrations are within the range of natural background and that Mesa Verde cactus appears to be tolerant and/or dependent upon substrate (e.g., Mancos and Fruitland shales) that are highly enriched in certain metals. Therefore, it does not appear that cumulative COPEC concentrations are likely harmful to Mesa Verde cactus.

6.2.6.3 Energy and Mineral Development

Energy and mineral development is extensive in the area occupied by Mesa Verde cactus. The development of the oil, gas, and coal resources has included the creation and expansion of roads, pipelines, power lines, and associated commercial and associated residential development.

In 1985, Ecosphere conducted surveys for BLM on all areas of potential habitat in the Hogback-Waterflow area. In their report they note that the San Juan Generating Station (brought online from 1976 to 1982) was built on Mesa Verde cactus habitat and that power transmission lines had been built through the Waterflow population (USFWS 2008). At least 90 percent of the total Mesa Verde cactus habitat is believed unlikely to be affected by coal mining because it occurs on geologic formations with uneconomical or no coal reserves (USFWS 2008).

Nearly all Mesa Verde cactus habitats have the potential to be affected by natural gas or oil exploration and production (USFWS 2008). Currently, some well fields have been established within or near cactus populations that occur on the Fruitland Formation; some of these occur on the Navajo Nation lands. Most Mesa Verde cactus habitats are on the Mancos Formation, with the Rattlesnake, Shiprock-Gallup, Horseshoe- Gallup, and Hogback oil fields located within high-quality Mesa Verde cactus habitat. Fields here are either still active or have been plugged. Habitat destruction in these areas is extensive (Roth 2008b). Humates are an additional extractable resource underlying some Mesa Verde cactus habitats (Ladyman 2004). Humate is used as a soil conditioner and additive to drilling muds. About 12.1 billion short tons of humate resources are within the San Juan River Basin (USFWS 2008).

In 2006, Western Area Power Administration destroyed about 20 miles of Mesa Verde cactus habitat, including 4.5 miles through the Malpais Conservation Area. Based on a 12-foot width, about 22 acres of what was at least moderate habitat was mowed (USFWS 2008).

6.2.6.4 Urbanization and Associated Effects

Beyond the drought's effects, the most significant impacts to Mesa Verde cactus are the numerous continuous, small conversions of habitat to urban use in the Shiprock area and to home-site development in the more rural areas. These losses are individually small but becoming cumulatively significant. Development of homes, roads, waterlines, recreation areas, and additional facilities continue to expand within and around the Shiprock area and are increasingly conflicting with Mesa Verde cactus habitat (Roth 2004). These effects are not severe on the Ute Mountain Ute Reservation in the Colorado portion of Mesa Verde cactus range (USFWS 2008).

ORV use is increasing as the population of the Navajo Nation and San Juan County, New Mexico, increases. Negative effects to Mesa Verde cactus and its habitat are evident in unauthorized roadways, trails, flattened and denuded landscape, and continually increasing sizes of such areas. ORV use was determined to be the greatest threat to the population at the time of listing, and several sites were noted as being heavily impacted by ORV use (USFWS 2008).

The amount of impervious land will increase with increasing population growth and urbanization. As impervious areas increase in a watershed, the delivery of atmospheric deposition fluxes to the water body will also increase (EPA 2005d).

6.2.6.5 Livestock Grazing

Livestock compact the soil, eliminating potential Mesa Verde cactus growth or recovery (USFWS 2008). Although the habitat that Mesa Verde cactus occupies would by most accounts be described as "barren," livestock grazing occurs across most of the occupied habitat. Nearly all surveys record some disturbance by livestock. In 1985, in surveys conducted for BLM, livestock trampling was recorded and one cow was documented eating a Mesa Verde cactus (USFWS 2008). Ladyman (2004) noted heavy sheep and cattle grazing at two Sheep Springs sites that once supported Mesa Verde cactus. Three additional sites noted extensive livestock damage (Ladyman 2004). In Colorado, livestock trampling was noted as the primary source of mortality in 2005 (CNAP 2005). Loss of cacti around homes and watering facilities is highly likely to occur to any Mesa Verde cacti occurring within the zone of intense livestock concentration through trampling and soil compaction. Of more recent concern are effects from large-scale roundups of Navajo Nation feral horse herds that result in compacted soils in Mesa Verde cactus habitat (Roth 2008b).

6.2.6.6 Disease and Predation

Mesa Verde cacti are susceptible to disease and predation. The native cactus longhorn beetle (*Moneilema semipunctata*) preys upon Mesa Verde cactus, usually with lethal consequences (USFWS 2008). This beetle may have caused significant, undocumented die-offs of Mesa Verde cactus in the past. The beetle cannot fly and is probably a resident within cactus populations. An estimated 80 percent of all Mesa Verde cactus succumbed to beetle attack in a large die-off in the early 2000s (Muldavin et al. 2003). The few cacti that survived this extreme episode of beetle predation were small juvenile plants that are less susceptible to attack (Sivinski 2003; Ladyman 2004). The army cutworm (*Euxoa* sp.) has also been associated with predation on Mesa Verde cactus. In 2003, many Mesa Verde cacti on BLM's Farmington Resource District were infested with cutworms that were eating both the stem and roots (BLM 2003a), and the cacti were thought to have perished from extreme army cutworm infestations during the drought (Roth 2004).

Some new Mesa Verde cactus are appearing from seeds in the soil seed bank, but they are immature and will take several years to become reproductively mature; therefore, USFWS assumes it will take many years for Mesa Verde cactus to return to former population levels (USFWS 2011d).

6.2.6.7 Climate Change

Highly specialized or endemic species, like Mesa Verde cactus, are likely to be most susceptible to the stresses of changing climate (USFWS 2008). Over a 41-year period, the average annual precipitation at Shiprock has been 6.93 in (Western Regional Climate Center 2008). In 1995, the annual precipitation equaled the long-term average; every year since then it has been below average. In 2002, no precipitation was recorded and, in 2004, 1.27 inches was recorded, the third lowest level measured since 1926. Mean annual precipitation since 1996 has been 3.96 inches, well below the long-term average. In no other period since 1926 have so many consecutive years of precipitation fallen below the average (Western Regional Climate Center 2008). Concurrent with below average precipitation are above average temperatures, which may further stress the plants, particularly in summer. Although warmer air temperatures alone may not have an effect on the species, it is evident that widespread and/or long-lasting drought can be devastating. Changes in precipitation patterns that lead to either wetter or drier conditions for this narrow endemic could lead to conditions that are no longer suitable for its survival. In addition, climate changes could lead to the establishment or spread of non-native plants, to the detriment of Mesa Verde cactus. Because it has been observed that germination and recruitment improve in years of normal or above normal precipitation, it is expected that recovery from the population decline in the early 2000s will be slow under current conditions of below average precipitation.

6.2.7 Fickeisen plains Cactus

6.2.7.1 General Factors

This cactus has very specific habitat requirements, low seed production, and a scattered distribution; it is considered naturally rare (Benson 2014). Current threats include trampling by livestock, non-native invasive species, rodent and rabbit herbivory, drought, and climate change that exacerbate the effects of small population size (USFWS 2013e). The species is a narrow endemic restricted to Kaibab limestone-derived soils. Because of its rarity and disjunct occurrence, this cactus is vulnerable to depopulation by damage to areas where it occurs. The species seems to have low reproductive capacity, even during favorable weather conditions. Other threats include ORV use, disturbance from road maintenance, and collection. This species is considered in management planning for many of the lands on which it occurs (USFWS 2013e; Benson 2014).

6.2.7.2 Energy and Mineral Development

Energy and mineral development does occur in the habitat area occupied by Fickeisen plains cactus. The development of the oil, gas, and coal resources could include the maintenance, creation, and expansion of roads, pipelines, power lines, and associated commercial and associated residential development that create ground disturbances in suitable habitat.

6.2.7.3 Urbanization and Associated Effects

Beyond the effects of the drought, the most significant impacts to Fickeisen plains cactus are the numerous small collective impacts to habitat from ORV, livestock grazing, road maintenance, and collection. These losses are individually small but becoming cumulatively significant. (Benson 2014).

ORV use is increasing as the population of the Navajo Nation increases. Negative effects to Mesa Verde and Fickeisen plains cactus and its habitat are evident in unauthorized roadways, trails, flattened and denuded landscape, and continually increasing sizes of such areas. (USFWS 2009).

6.2.7.4 Livestock Grazing

Livestock compact the soil, trample individuals, and can eliminating potential cactus growth or recovery. Although the habitat that the cactus occupies would by most accounts be described as “barren,” livestock grazing occurs across most of the occupied habitat. Nearly all surveys record some disturbance by livestock. Because of its rarity and isolated occurrence, this cactus is vulnerable to depopulation by damage to areas where it occurs (USFWS 2013e).

6.2.7.5 Predation

Current threats include rodent and rabbit herbivory that may impact the effects of the current small population size (USFWS 2013e).

6.2.7.6 Climate Change

Highly specialized or endemic species, like Fickeisen plains and Mesa Verde cactus, are likely to be most susceptible to the stresses of changing climate. Over a 41-year period, the average annual precipitation at Shiprock has been 6.93 in (Western Regional Climate Center 2008). In 1995, the annual precipitation equaled the long-term average; every year since then it has been below average. In 2002, no precipitation was recorded and, in 2004, 1.27 inches was recorded, the third lowest level measured since 1926. Mean annual precipitation since 1996 has been 3.96 inches, well below the long-term average. In no other period since 1926 have so many consecutive years of precipitation fallen below the average (Western Regional Climate Center 2008). Concurrent with below average precipitation are above average temperatures, which may further stress the plants, particularly in summer. Although warmer air temperatures alone may not have an effect on the species, it is evident that widespread and/or long-lasting drought can be devastating. Changes in precipitation patterns that lead to either wetter or drier conditions for this narrow endemic could lead to conditions that are no longer suitable for its survival. In addition, climate changes could lead to the establishment or spread of non-native plants, to the detriment of both Fickeisen plains and Mesa Verde cactus.

7 Effects of the Proposed Action on Federally Listed Species

Effects of the action means the direct and indirect effects of an action on the species or designated critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Indirect effects are those that are caused by a proposed action and are later in time, but are still reasonably certain to occur. If a proposed action includes off-site measures to reduce net adverse effects by improving habitat conditions and survival, the USFWS will evaluate the net combined effects of that proposed action and the off-site measures as interrelated actions.

Interrelated actions are those that are part of a larger action and depend on the larger action for their justification; 'interdependent actions' are those that have no independent utility apart from the action under consideration (50 CFR 402.02). Future federal actions that are not a direct effect of the action under consideration, and not included in the environmental baseline or treated as indirect effects, are not considered in this BA.

The Proposed Action, which includes future activities at the mine, power plant, and transmission lines, was developed to incorporate all interrelated/interdependent activities.

7.1 Colorado Pikeminnow and Razorback Sucker

The distribution of Colorado pikeminnow and razorback sucker overlaps substantially within the Action Area and both species have many similarities in their habitat needs and face many of the same potential threats to their persistence and recovery. Therefore, these species are discussed together in the effects analysis. Where the effects would differ for the species, these differences are described within this section.

7.1.1 Navajo Mine

Colorado pikeminnow would not occur within the area directly affected by Navajo Mine or the Pinabete Permit Area, but do occur in the San Juan River, and presumably in the portion of the Chaco River near the mouth that has perennial water. Pikeminnow and razorback sucker could be affected by changes in hydrology associated with mining operations, as well as runoff from the mine that could contain sediment or other contaminants.

7.1.1.1 Hydrology

The San Juan Basin Watershed encompasses a 24,908-square-mile drainage within USGS' Hydrologic Unit Code 1408. The Navajo Mine, Pinabete, and FCPP lease areas are within Chaco River Watershed (Hydrologic Unit Code 14080106), which drains 4,563 square miles. The mine lies on the eastern side of the basin. Mining would not be conducted in Cottonwood or Pinabete arroyos, the primary washes through the Pinabete Permit Area, although runoff from tributary drainages may be intercepted during mining activities. This interception may diminish runoff flows from these areas into the Chaco River; however, impacts would be negligible because Pinabete and Cottonwood arroyos are a small portion of the regional Chaco River watershed.

Cottonwood Arroyo is a major sand bed ephemeral drainage that passes through the northern portion of the Pinabete Permit Area. Cottonwood Arroyo is one of the largest of the Chaco River tributaries with a drainage area of approximately 80.1 square miles (1.8 percent of the Chaco River Basin), though only approximately 6 percent of the drainage area is within the permit area. Pinabete Arroyo has a drainage area of about 60 square miles (1.4 percent of the Chaco River Basin); approximately 16 percent is within the Pinabete Permit Area. Together the area of the mine drained by these washes is about 0.3 percent of the total area of the Chaco River watershed. The interception of flows from within and upgradient of the mine would affect ephemeral flows in these washes and would not be expected to measurably affect flows in the Chaco or San Juan rivers. These drainages would be reconnected as mined areas are reclaimed, restoring the natural flow patterns (OSMRE 2014). Therefore, hydrologic changes caused by mining would not affect Colorado pikeminnow or razorback sucker or their critical habitat.

7.1.1.2 Sediment and Contaminant Runoff

NTEC would implement sediment control practices in accordance with the SMCRA permitting requirements to help minimize sediment loss from water and wind erosion, including such methods as stabilizing stockpiles by mulching and seeding and retaining sediment in disturbed areas using berms, sumps, or sediment ponds to capture runoff. The primary control measure to decrease sediment runoff would be the use of sedimentation ponds. Sedimentation ponds are designed to retain the surface runoff and sediment from either the 100-year, 6-hour or 10-year, 24-hour storm event. No discharge would occur onto undisturbed areas or beyond the Navajo Mine Lease or Pinabete Permit areas from precipitation events up to and including the 10-year, 24-hour event. All discharges from the disturbed areas would be covered under an NPDES permit where required. NTEC would acquire general NPDES stormwater permits as applicable. Professional Engineers would design and certify that sedimentation ponds would contain runoff from a 100-year, 6-hour or 10-year, 24-hour storm event. Should discharges occur from these ponds, they would be subject to the applicable NPDES discharge effluent limitations of MSGP Subpart H. Berms, v-ditches, or channels would be used to divert flows from the disturbed areas into the ponds. Retaining the effluent or surface runoff from the disturbed areas in the pond for evaporation would ensure compliance with the applicable effluent standards set forth in the NPDES permit.

SEDCAD modeling was performed to evaluate sediment generation under pre-mine, operational, and post-reclamation conditions for drainages traversing or intersecting the Navajo Mine Lease Area (OSMRE 2014). Within the lease area, effects were assessed with the modeling of the Chinde Wash, Hosteen Wash, Barber Wash, Neck Arroyo, South Barber Drainage, Lowe Arroyo, and Cottonwood Arroyo. The results indicate that sediment yields in all water bodies would be lower than or equal to yields under operational conditions in comparison with pre-mine baseline yields. For the Pinabete Permit Area, the effects were assessed with the modeling of Pinabete Arroyo at the confluence with the Chaco River, Cottonwood Arroyo at the confluence with the Chaco River, and the unnamed tributary to Chaco River downstream of the permit boundary. Sediment yields reaching the Chaco River from Pinabete Arroyo, Cottonwood Arroyo, and the Unnamed Tributary to Chaco River would be lower under operational conditions in comparison with the pre-mine baseline yields. In addition, the results suggest that the replacement of poor quality sodic soils with suitable topdressing materials would reduce sediment generation from pre-mine to post-reclamation levels. The exception appears in the Pinabete Arroyo watershed, where the additional drainage area combined with a slight increase in the slope/length factor resulted in slightly larger sediment yields.

As part of reclamation, NTEC would remove temporary post-reclamation structures. After erosion control measures sufficient to minimize the erosion rate to less than or equal to pre-mine levels have been installed, the reclamation areas would be reconnected to the native drainages that surround the permit area in accordance with SMCRA regulations. To prevent possible degradation of the downstream reclaimed or topdressed and seeded areas, berms and ditches would remain in place as long as practicably possible during topdressing placement. Generally, berms would be removed by blending the material into the adjacent regraded spoils.

In addition, NTEC would continue quarterly monitoring of surface-water quality and quantity at two locations in the Chinde Wash. NTEC would also conduct regular monitoring of surface-water quantity and quality in Pinabete and Cottonwood arroyos for the duration of the permit period. Monitoring would be conducted at five stations (three historic and two new stations) and would be collected quarterly and submitted to OSMRE in accordance with the Surface Water Monitoring Plan submitted as part of the

Navajo Mine SMCRA Permit and the Pinabete Permit Application. Motor fuel storage and equipment maintenance would be provided at the Navajo Mine facilities located outside of the Pinabete Permit Area. Equipment repair may on occasion need to be conducted within the active mining or reclamation areas. NTEC maintains and implements a SPCC Plan that identifies areas of risk, specifies appropriate controls for bulk storage areas, identifies control strategies for managing potential spills, and lists procedures for safely disposing of any contaminated materials. Thus, no contamination of natural waters would be expected to occur and there would be no effect from contaminants from the mine on Colorado pikeminnow or razorback sucker.

7.1.1.3 Hazardous Materials

As described in more detail in Section 4.15.2 of the Project EIS (OSMRE 2014), the types and quantities of hazardous materials stored on the Navajo Mine Lease Area are minor, and they are below the levels that require reporting under Emergency Planning and Community Right-to-Know Act, Section 313 (BNCC 2012c). Programs are in place at the Navajo Mine that address hazardous materials storage locations, emergency response procedures, employee training requirements, fire safety, first-aid/emergency medical procedures, and hazardous materials release containment control procedures (BNCC 2012c; OSMRE 2012a). The purpose of these programs is to ensure proper management of these materials and to specify how personnel would respond to any unplanned release of hazardous materials to the air, soil, or surface water. This response includes notifying the proper authorities of the release, controlling and cleaning up the release, and restoring the environment as required. NTEC has implemented a SPCC Plan for Navajo Mine. The objectives of the SPCC Plan are to prevent the discharge of oil products and to perform safe, efficient, and timely response in the event of a spill or leak. The SPCC Plan covers all facilities that could reasonably be expected to discharge oil into, or upon, navigable waters.

NTEC operates a waste storage facility at the Area 3 Industrial Complex for the temporary storage of wastes before they are transported off site. Nonhazardous wastes are stored in dumpsters at designated areas around the mine site and transported by a third-party contractor to San Juan County Regional Landfill or other permitted solid waste landfill for disposal. Hazardous and universal wastes (e.g., aerosols, antifreeze, paint and related materials, and batteries) and special wastes (e.g., absorbents, rubber hoses, used oil filters, and railroad ties) are accumulated, managed, and disposed of in accordance with applicable EPA and Department of Transportation regulations (BNCC 2012d).

It is not anticipated that any new hazardous materials would be brought on site or new wastes generated under the Proposed Action. In the event that any are, they would be subjected to an internal approval process before they are brought on site, and the existing storage, handling, and emergency spill response procedures would be reviewed and updated to ensure that these materials are adequately addressed in those plans. Existing hazardous materials and waste storage areas for the Navajo Mine Permit Area are adequately sized to handle any relatively small increase of hazardous materials or wastes associated with the Proposed Action (BNCC 2012c). Hazardous and universal wastes (e.g., aerosols, antifreeze, paint and related materials, and batteries) and special wastes (e.g., absorbents, rubber hoses, used oil filters, and railroad ties) would continue to be accumulated, managed, and disposed of in accordance with applicable EPA and Department of Transportation regulations (BNCC 2012d).The hazardous materials and waste storage, handling, transportation, and disposal management programs for the existing Navajo Mine are listed in Section 4.15.1 of the EIS (OSMRE 2014) and meet regulatory requirements for these activities; therefore, these programs along with the engineering controls identified in the programs are adequate for mitigating any potential hazardous materials releases or spills. Based on the quantities and types of hazardous materials on site, the existing protocols to prevent any release of these materials into the environment and the existing plans to address any accidental release, release of hazardous materials at the Navajo Mine is would not affect wildlife resources, including Colorado pikeminnow and razorback sucker.

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7.1.2 Four Corners Power Plant

FCPP would be anticipated to potentially affect Colorado pikeminnow and razorback sucker through runoff from the FCPP Lease Area, diversions from the San Juan River at the APS Weir, release of water and non-native fish from Morgan Lake, and deposition of contaminants released from the stacks of Unit 4 and 5.

7.1.2.1 Runoff from FCPP Lease Area

7.1.2.1.1 Groundwater

The continued operation of Units 4 and 5 would not affect groundwater quantity. The water demands for FCPP operation come from Morgan Lake via the San Juan River, and no groundwater is pumped or otherwise used for the FCPP. No injection of material into the subsurface is planned. FCPP would continue monitoring groundwater quality and level. However, operation of the ash disposal facility, including existing trenches and extraction wells, would result in a decline in groundwater flow.

Selenium concentrations beneath the Ash Disposal Area exceed EPA drinking water quality standards (APS 2013). Boron, nickel, and uranium are also elevated in some instances. Although boron and uranium are naturally occurring elements found in the geologic formations of the region, it is unclear if the ash ponds or native material is the source of these and the other constituents.

In 1977, APS constructed an open ditch system to collect seepage water from the ash disposal facilities as part of the FCPP NPDES permits. In 1993 and 2011 extraction wells were installed. These systems are designed to prevent contamination of Chaco Wash. In October 2011, APS constructed a north intercept trench excavated to the bottom of the shale formation. A review of groundwater-level data and water quality data in three wells located downgradient of the trench show declines in all constituents and groundwater level. APS completed installation of a second south intercept trench to remediate groundwater in 2013. APS is monitoring the performance of the south intercept trench. With the operation of the intercept trenches, continued operation of the ash disposal ponds would have little potential to contaminate local groundwater and water quality in Chaco Wash and, therefore, would not affect Colorado pikeminnow or razorback sucker.

7.1.2.1.2 Surface Water

The site of the primary FCPP facilities (Units 1 through 5 and associated facilities and parking lots) is a generally paved area, graded locally to surface inlets and catch basins and eventually to the discharge canal. The low-volume wastewater facility collects and treats surface-water runoff and wastewater resulting from the operation of Units 4 and 5, which is then discharged to Morgan Lake. Types of wastewater include chemical and oily wastewater, process wastewater, and ash-handling wastewater.

The remaining portions of the FCPP Lease Area are unpaved and consist of Morgan Lake, the ash disposal areas, and other open, undeveloped areas. Runoff from these areas is not expected to change as a result of the Proposed Action. The volume of wastewater would decrease in the future with the closure of Units 1, 2, and 3, but is not expected to affect surface-water runoff, as all wastewater is treated and retained on site. Therefore, this wastewater would not affect Colorado pikeminnow and razorback sucker.

7.1.2.2 Releases of Non-Native Fish from Morgan Lake

Morgan Lake discharges into No Name Wash, which drains to the Chaco River and from there into the San Juan River. Morgan Lake supports several species of non-native fish. While Colorado pikeminnow and razorback sucker do not occupy Morgan Lake, the discharges from Morgan Lake could result in the release of non-native species into the San Juan River. Non-native fish have been identified as one of the threats to both Colorado pikeminnow and razorback sucker. As described in Section 5.1.6.2, non-native fish have the potential to compete with and prey upon native fish, including Colorado pikeminnow and razorback sucker, and may also serve as vectors for disease and parasites. While the San Juan River currently supports populations of many of these non-native fish, release of these fish from Morgan Lake could help support these populations. In addition, some of the non-native fish in Morgan Lake (e.g., gizzard shad) do not have populations in the San Juan River, and if such populations became established, they could exacerbate the existing non-native fish problem. Release of non-native fish from Morgan Lake may affect and is likely to adversely affect Colorado pikeminnow and razorback sucker.

7.1.2.2.1 Water Quality

Water used at the FCPP is cycled from Morgan Lake through the power plant condenser for cooling and discharged back into the lake. The continued operation of Units 4 and 5 would result in no changes to the quality of water released to Morgan Lake or ultimately the San Juan River. The temperature of the water discharged into Morgan Lake and ultimately No Name Wash and the Chaco River is greater than that brought into the FCPP. However, this increase in temperature does not increase temperature in No Name Canal or Chaco River above water quality standards. Therefore, continued operations regarding uptake and discharge of water from Morgan Lake would not adversely affect surface-water quality of water bodies in the FCPP vicinity or affect Colorado pikeminnow or razorback sucker.

Toxic Substances in Plant Area

In accordance with their NPDES permit, FCPP operates under a SWPPP. As described above, stormwater within the FCPP Lease Area either is contained via berms, discharged to Morgan Lake, or drains to one of three outfalls on site.

In addition, the following Structural Controls are used on site:

- Chemicals stored inside the Main and Chemical warehouses
- Oil totes stored in oil storage buildings in the FCPP
- Concrete apron over the dirt bank at 4/5 Intake (SW1)
- Prompt cleanup of spills and leaks using absorbents to prevent the discharge of pollutants
- Drip pans and absorbents are used under or around leaky vehicles and equipment
- Washwater drains to a proper collection system
- Rock and concrete barriers surrounding the perimeter of the plant proper next to Morgan Lake and cooling water canals leaving and entering the lake (APS 2012a)

Under the Proposed Action, FCPP would continue to operate in accordance with the existing NPDES permit and the SWPPP. Therefore, stormwater discharge during continued operations would have no adverse effects on water quality within the FCPP Lease Area. On-site drainage areas also provide secondary containment that isolates any potential discharges from the San Juan River. Therefore, no effect from toxic substances in the FCPP area would occur to Colorado pikeminnow or razorback sucker.

7.1.2.3 Ash Disposal Area

The FCPP Lease Area includes a number of inactive ash disposal areas including Ash Ponds 1-6 and the gridded disposal area. Currently, active facilities include the LAI, which since the shutdown of Units 1,2, and 3 receives flue gas emission control residuals, boiler acid cleaning waste, treated sewage, chemical metal cleaning wastes, air preheater wash, co-disposal waste, and turbine foam cleaning waste, and the LDWP, which is intended to retain liquid decanted from the LAI.

These facilities are lined and all dikes are constructed in accordance with specifications approved by the New Mexico Office of the State Engineer, Dam Safety Bureau. A safety inspection of the LAI and LDWP dikes was performed in 2009. The inspection, conducted by a professional engineering company specializing in dam safety, found the dikes to be satisfactory and states that "No existing or potential management unit safety deficiencies are recognized. Acceptable performance is expected under all applicable loading conditions (static, hydrologic, seismic) in accordance with the applicable criteria. Minor maintenance items may be required" (GEI Consultants 2009).

An Emergency Action Plan (EAP) for the LAI and the LDWP was prepared that addresses emergency procedures in the unlikely event of a dam failure (APS 2011). The EAP prepared for the LAI and LDWP identifies potential emergency conditions that could develop at the LAI and LDWP, provides a plan for communication of the conditions, and specifies preplanned actions to be followed to minimize property damage and loss of life. The EAP also provides procedures and information to assist FCPP in issuing early warning information of the emergency situation to responsible emergency management authorities.

Overall, the EAP's purpose is threefold:

- Safeguard the lives and reduce property damage of the citizens living within the LAI and LDWP potential flood or inundation area.
- Provide effective plans for surveillance of the LAI and LDWP, prompt notification to local emergency management agencies, and citizen warning and evacuation response, when required.
- Assign emergency actions to be taken by the dam operator/owner, public officials, and emergency personnel, and outline responsibilities of each party involved in the emergency management process in the event of a potential or imminent failure of the LAI and LDWP.

The EAP greatly reduces the potential for the failure of the dams and levees associated with the ash disposal area and provides for the containment of any such release.

The DFADA is an active, lined landfill facility that was constructed in 2007 and is used for disposal of dry fly ash from Units 4 and 5 as well as small amounts of construction debris.

In the future, Units 4 and 5 FGD waste will be mixed with flyash and placed in the DFADA. DFADA Site 1 is tallest on the West Berm, approximately 110 feet above natural grade. DFADA Site 2 utilizes a composite liner system. DFADA Sites 1 and 2 are projected to reach capacity by 2016. Therefore, additional DFADA sites will be needed in the future to accommodate dry fly ash/FGD disposal through 2041.

In the ash disposal area, BMPs such as silt fences, berms, and settling basins are and will be used to control stormwater runoff. Therefore, no adverse effects to water quality would result from stormwater runoff associated with the proposed new ash disposal facility. No effects to Colorado pikeminnow or razorback sucker would occur from this portion of the Proposed Action.

7.1.2.4 Diversions from the San Juan River

Surface water drawn from the San Juan River into Morgan Lake for use at the FCPP is obtained according to water rights for 51,600 af/yr diversion, 39,000 af/yr consumptive held by BBNMC, with average withdrawals of 27,682 af/yr. With the closure of Units 1-3, the diversion of water for use at the FCPP is expected to decrease by approximately 5,000-7,000 af/y. No changes to the water rights or water use would occur under the Proposed Action, and NTEC (and the FCPP) would maintain the ability to draw as much water as the rights allow for the Project life. Future operations are expected to maintain the same level of diversions and consumptive use as historic operations. As described in Section 6.2.1.2.2, these water rights have been accounted for in the SJRRIP's water accounting and factored into the flow recommendations for the San Juan River (Reclamation 2006; USFWS 2006). The consumptive water rights of 39,000 af/y represent approximately 6 percent of the total depletions of the San Juan River in New Mexico and about 4.5 percent of the total basin depletions. Average historic use less 5,000 af/year for the shutdown of Units 1-3, represents about 3.7 percent of New Mexico depletions and 2.7 percent of total basin depletions.

The APS Weir at RM 163.3 lies within the designated critical habitat for Colorado pikeminnow and upstream of designated critical habitat for razorback sucker. It may impede fish passage during some times of the year (Bio-West 2005), but Colorado pikeminnow and razorback sucker and other species have been

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observed to pass this structure under some conditions. Bio-West found that both species would likely be able to pass over the right embankment of the dam at flows higher than 5,000 cfs, but passage is likely somewhat impaired at flows between 500 and 5,000 cfs, however they note that Colorado pikeminnow, razorback sucker, and other species have moved upstream past the APS weir, although the specific flows at which they did so is unknown because recaptures "were separated by hundreds of days". One Colorado pikeminnow was observed to pass the weir at flows between 671 and 741 cfs (Bio-West 2005).

The full extent of this blockage is not known at this time because the swimming performance of Colorado pikeminnow and razorback sucker are not well known; however, the Bio-West study documents that the hydraulic drop associated with the weir may prevent these species from swimming over the crest of the weir at flows below 2,000 cfs, and high velocities may prevent them from swimming over the crest of the weir at flows of 2,000 to 5,000 cfs. Fish may be able to move through the sluiceway of the weir when flows are less than 500 cfs, particularly if the gate is fully open. The impairment of fish passage at the weir could limit the ability of Colorado pikeminnow and razorback sucker to move within the river to different areas in response to changing needs and environmental conditions. This could reduce the amount of accessible spawning and rearing habitat under some conditions, and may reduce habitat availability for the species. Temperatures upstream of the APS Weir are likely too cool to support spawning and rearing of Colorado pikeminnow (Durst and Franssen 2014). However the weir lies within the critical habitat for Colorado pikeminnow, and results in adverse modification of this habitat. The weir lies upstream and outside of the designated critical habitat for razorback sucker, therefore no effect on designated critical habitat would occur for this species.

The two 10- by 10-foot intakes at the APS diversion are screened with 1- by 3-inch mesh screens. The approach velocity to these screens is 0.38 foot per second. The approach velocities at the APS diversion are within the sustained swimming speeds reported by Bio-West (2005) for Colorado pikeminnow and razorback sucker larvae and young-of year, as well as those of larger fish, which are substantially higher, so fish could avoid being entrained or impinged on the screens. However the behavioral response of the fish to the intakes is unknown. Fish are often drawn to the shade provided by intakes, so it is likely that fish could be entrained. The mesh size of the screens would allow larvae, young-of year, and some smaller juvenile pikeminnow and razorback sucker to become entrained. No entrainment studies have been done, so the level of entrainment is unknown. It is likely that razorback sucker stocked into the river are too large to be entrained. However, Colorado pikeminnow are stocked at smaller sizes and are vulnerable. Naturally produced larvae and small juveniles of both species would be vulnerable to entrainment. The entrainment of larvae and juveniles may affect and would likely adversely affect both species.

The intakes are runs in two modes, pumping either 17,000 or 32,000 gpm (approximately 37 and 71 cubic feet per second [cfs], respectively) from the San Juan River. The intake is operated at any time of day, as needed. The 17,000 gpm mode is generally used during the October to May timeframe, and the 32,000 gpm mode is generally used during the May through October timeframe. Following the approach used in the Navajo Gallup BO (USFWS 2009), the proportion of Colorado pikeminnow and razorback sucker that could be entrained is estimated based on the proportion of the population that could occur above the FCPP weir and the proportion of the flow that is diverted.

7.1.2.4.1 Entrainment Effects on Colorado Pikeminnow

Colorado pikeminnow larvae typically enter the drift from mid-July to early August and drift passively for 3 to 6 days after emergence (USFWS 2009). Larvae would be subject to loss at the diversion for about 30 days. Because the fish drift with the currents, it is assumed that they would be entrained in direct proportion to the amount of flow diverted and the proportion of larvae that enter the drift upstream of the diversion point. Mean daily flows from mid-July to mid-August averaged about 1,030 cfs during this time period from 2003 to 2013 (USGS Gage 09365000). During this timeframe, approximately 71 cfs, or approximately 7 percent of the flow, would be diverted to Morgan Lake. With the reduced diversions of 5,000 to 7,000 af/y resulting from the shutdown of Units 1-3, total diversions would be 18 to 25 percent less. These reductions would be attained by operating the diversion less frequently, but when the diversion was in operation, approximately 7 percent of the flow would be taken, but the total amount of water diverted would be less than 7 percent of the total flow, The USFWS (2009) estimated that spawning could occur between RMs 128 and 180. The APS Weir is located at approximately RM 163.3, so about 26 percent of the available spawning habitat could lie above the weir, assuming an equal distribution of spawning habitat throughout the reach. While no spawning activity has been observed above the weir, spawning activity has been poorly documented because of the very limited number of adult pikeminnow in the system. Lacking information on the spawning distribution of Colorado pikeminnow, an assumption of equal distribution of spawning habitat is reasonable. Based on about 26 percent of the population spawning above the APS Weir and 7 percent loss of those individuals, it is estimated that about 1.8 percent of the population of larvae could be lost to the diversion. With the reduced diversions described above and assuming an equal distribution of larvae over time, the loss would be reduced to 1.4 to 1.5 percent of the population.

However, water temperatures near Farmington (RM 180), generally do not exceed 20°C and only exceed 18°C from mid-July to mid-August (Durst and Franssen 2014). Colorado pikeminnow generally spawn at temperatures of 18 to 23°C (USFWS 2002a). These cold temperatures make conditions less suitable for spawning near Farmington and for some distance downstream. Known spawning locations are located further downstream in “the Mixer” (RM 130-134) and in the Four Corners area RM 119), and spawning has not been documented above the APS weir (USFWS 2009).Thus, it is likely that the area above the APS weir will not be used for spawning to the same extent as areas further downstream, if it is used at all. Therefore, it is likely that entrainment of larval Colorado pikeminnow will be substantially less than the 1.4 to 1.8 percent cited above.

The SJRRIP currently stocks the San Juan River with Colorado pikeminnow. Approximately 300,000 to 400,000 Colorado pikeminnow approximately 6 months of age (50 TO 65 mm in size) are stocked each year. Historically, larger fish have been stocked, but there are no plans to do so in the future. Since 2007 nearly all of these fish have been stocked above the APS Weir. These fish could also be vulnerable to entrainment at the diversion. These fish are stocked in October and November when flows are 728 to 1,530 cfs (USGS Gage 09365000). The diversion is typically operating in the 17,000 gpm mode during this time (37 cfs), and is diverting between 2.4 and 5.1 percent of the flow. These fish actively swim and do not drift passively, as the larvae do, so they would not necessarily be entrained in proportion to the amount of flow diverted. Behavioral characteristics are known to influence the entrainment risk of fish. However, these characteristics are unknown for Colorado pikeminnow, and so it cannot be predicted whether their entrainment risk would be higher or lower than that predicted by the proportion of water diverted. Therefore, the following estimate is based on the proportion of water diverted, with the assumption that 100 percent of the fish are stocked above the diversion, and that these fish move proportionally with the flow, between 7,200 and 20,400 of these fish could be entrained annually.

A study of entrainment at Hogback, Farmers Mutual, Jewitt Valley and Fruitland Irrigation diversions conducted in 2004 and 2005 indicates that the proportion of stocked fish entrained in the canals is considerably lower than what would be predicted based on the proportion of flow diverted (Renfro et al. 2006). This study found that between 0.002 and 0.004 percent of Colorado pikeminnow stocked shortly before the study was conducted were observed in Hogback and Fruitland Irrigation diversions (no razorback sucker were observed, although other native suckers were). While this study likely did not capture every Colorado pikeminnow entrained, it provides an indication that the magnitude of the effect is likely to be less than 0.5 percent of the abundance of recently stocked fish, even allowing for a 100-fold underestimate of the number of fish actually entrained. These data indicate entrainment of 1,500 to 2,000 recently stocked fish might be expected.

Colorado pikeminnow would remain vulnerable to entrainment for some time after the initial stocking. The exact size of a pikeminnow vulnerable to entrainment at the 1 by 3 inch screens at the intake is unknown at this time. The most vulnerable time for these fish is shortly after release as these fish distribute themselves within the river. It is not known how far or how rapidly these fish would disperse. Fish that successfully move downstream of the APS Weir would be less likely to be subsequently entrained because of the passage restrictions at the Weir, previously discussed.

Currently, few naturally produced Colorado pikeminnow are present in the San Juan River, so little, if any, take of wild fish would occur. As the species moves toward recovery and more natural reproduction occurs, then take would be more likely to occur. It is probable that most natural reproduction would occur primarily below the APS Weir, because of the cool temperatures near Farmington, however, the proportion of spawning that might take place above the weir is unknown. Currently, the only known natural spawning occurs downstream of the APS Weir, and no known spawning sites have been observed upstream of the APS Weir (USFWS 2009), therefore the larvae and young fish produced would not be exposed to entrainment at the Project intakes.

7.1.2.4.2 Entrainment Effects on Razorback sucker.

The diversion of water to Morgan Lake from the San Juan River could entrain razorback sucker. Razorback sucker spawn on the ascending limb of the hydrograph during the spring. Larvae are found in the drift from late March to early July. Spawning is assumed to occur between RM 100 and 180, with the effort spread evenly throughout the reach (USFWS 2009), however no spawning has been documented to occur above the APS weir. The intakes are about 16 miles below the top of the reach and thus affect about 20 percent of the potential habitat. Average flow during the spawning season between 2003 and 2007 ranged from 717 to 6,455 cfs (USFWS 2009). During the spawning season, the Proposed Action would divert 37 cfs in March and April and 71 cfs in May and June. Thus the Proposed Action would divert between 0.6 percent of the flow in low diversion operations at high flows and 9.9 percent of the flow at high diversion operations at low flows. The potential entrainment of recently, naturally spawned fish would be 0.12 to 2.0 percent of the fish spawned. Razorback suckers spawn at cooler temperatures than Colorado pikeminnow (>14°C, USFWS 2002b, with spawning occurring at temperatures between 11.3 and 15.6 in the Gunnison and Colorado rivers [Osmundson and Seal 2009]), and therefore the cooler temperatures at Farmington would not have as great an effect on their spawning. With the shutdown of Units 1-3, the diversion would be operated would be 18 to 25 percent less often, but the relative volume of water diverted would be as described above. The reduced operation would reduce entrainment below the levels described above.

Razorback sucker are stocked into the river at a length of approximately 300 mm (approximately 1 foot). These stocked fish would not be anticipated to be vulnerable to entrainment and low approach velocities would not be result in impingement of these fish on the screens.

Renfro et al. (2006) did not observe any razorback sucker in the Hogback, Farmers Mutual, Jewitt Valley and Fruitland Irrigation diversions during an entrainment study conducted in 2004 and 2005. This may indicate this species is somewhat less likely to be entrained, particularly at the sizes at which they are stocked into the San Juan River. However, this may also be the result of other factors such as the timing of the study (September to November) in relation to the life history activities of razorback sucker. It is possible that entrainment may occur at other times of year.

7.1.2.5 Hazardous Materials

Programs are in place at the FCPP that address hazardous materials storage locations, emergency response procedures, employee training requirements, fire safety, first-aid/emergency medical procedures, and hazardous materials release containment control procedures (APS 2012b).

For chemical spills and emergencies, the FCPP response procedures are outlined in the Station Fire/Emergency Contingency Plan (APS 2012b). Small spills are fully managed by FCPP employees. If spills are larger or have significant risk, the FCPP would contract with cleanup vendors for spill cleanup. As described in the Station Fire/Emergency Contingency Plan, the on-shift fire crew chief in charge of the incident would determine whether additional off-site support is required. Oil spill contingency and cleanup procedures are outlined in a site-specific SPCC Plan.

To ensure proper storage and disposal of hazardous waste, the FCPP maintains a Hazardous Waste Management Plan (APS 2012b). This plan includes the specific requirements associated with identification, storage, and disposal of hazardous wastes. Under normal operating conditions, the FCPP is a Conditionally Exempt Small Quantity Generator because it generates less than 220 pounds of non-acute hazardous waste per month and has an on-site accumulation of less than 2,200 pounds of non-acute hazardous waste at any time.

Hazardous waste at the FCPP is stored in a centralized location prior to off-site disposal. In addition to the Hazardous Waste Staging Area, hazardous waste is staged at satellite locations near points of waste generation. Waste containers at the satellite locations are placed on the pavement or concrete, or inside buildings to minimize the risk if spilled. Documented inspections of both the staging area and the satellite areas are performed weekly (APS 2012b).

The quantities of hazardous materials stored on site are anticipated to decrease with the shutdown of Units 1, 2, and 3. Based on the quantities and types of hazardous materials on site, the existing protocols to prevent any release of these materials into the environment, and the existing plans to address any accidental release, release of hazardous materials at the FCPP would not affect wildlife resources and would not affect Colorado pikeminnow or razorback sucker or their habitat.

7.1.2.6 Atmospheric Emissions

With the shutdown of Units 1, 2, and 3, COPEC emissions from FCPP will be substantially reduced, as indicated in Table 2-9.

The ERAs reported that the Proposed Action (e.g., future emissions from the FCPP) by itself would not result in harm to Colorado pikeminnow and razorback sucker. The ERAs reported that HQs were much less than 1 for exposures relating to future FCPP emissions in Morgan Lake and in the San Juan River within the Deposition Area and downstream into the San Juan River arm of Lake Powell. The HQs reported in the ERAs are based on the maximum predicted future fish tissue concentrations. As shown in Tables 7-1 and 7-2, comparison of ERA results for both Morgan Lake and the San Juan River show that the contribution of the Proposed Action is very small relative to baseline conditions. These very small contributions would not measurably increase the existing effects associated with the environmental baseline.

Table 7-1 ERA Results for Morgan Lake Exposures to Fish under Baseline Conditions and the Proposed Action

	Baseline Conditions		Proposed Action	
COPEC	Tissue Concentration (mg/kg ww)	Hazard Quotient	Tissue Concentration (mg/kg ww)	Hazard Quotient
Chromium	1.1	8.9	0.000000049	0.00000038
Nickel	0.57	29	0.000000051	0.0000025
Selenium	3.5	6.5 – 190	0.00000012	0.00000022 - 0.0000066
Zinc	26	6.7	0.000000017	0.0000000043

Note: The HQs for selenium reflect the range of HQs for early life-stage fish to adult fish.

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Table 7-2 ERA Results for San Juan River Exposures to Fish under Baseline Conditions and the Proposed Action.

COPEC/ Species	Baseline Conditions		Proposed Action	
	Tissue Concentration (mg/kg ww)	Hazard Quotient	Tissue Concentration (mg/kg ww)	Hazard Quotient
Chromium	2.0	15	0.00000004	0.00000032
Copper	3.0	1.8	0.00	0.00
Lead	1.7	5.0	0.00000085	0.0000025
Mercury/FF	0.22 - 0.31	0.27 - 12	0.000023 - 0.000053	0.000029 - 0.0021
Mercury/CPM1	0.22 - 0.31	0.27 - 12	0.000040 - 0.00016	0.000050 - 0.0063
Mercury/CPM2	0.22 - 0.31	0.27 - 12	0.000094 - 0.00025	0.00012 - 0.010
Mercury/RS1	0.22 - 0.31	0.27 - 12	0.000024 - 0.000047	0.000030 - 0.0019
Mercury/RS2	0.22 - 0.31	0.27 - 12	0.000047 - 0.000073	0.000059 - 0.0029
Selenium	1.5 - 3.9	2.8 - 220	0.00099 - 0.0018	0.055 - 0.10
Zinc	70	18	0.000000021	0.0000000055

Note: Tissue concentrations and HQs reported in the San Juan River ERA reflect the range of concentrations across the four areas evaluated in the San Juan River.

CPM1 = Colorado pikeminnow < 400 mm

CPM2 = Colorado pikeminnow >400 mm

FF = forage fish

RS1 = razorback sucker < 400 mm

RS2 = razorback sucker >400 mm

7.1.3 Transmission Lines

7.1.3.1 Inspection

Inspection of the APS and PNM transmission lines occurs through annual aerial surveys and less frequent ground surveys. During ground surveys, inspectors utilize existing roads. These roads are maintained by the local landowner for the APS ROWs and they do not conduct road maintenance activities. PNM does conduct some road maintenance, as described below and in Section 2.5.3.2. The only line that intersects habitat for Colorado pikeminnow and razorback sucker is the PNM FC line, which crosses the San Juan River northeast of the FCPP. The towers of this crossing are located outside of the riparian zone. These inspections would not affect Colorado pikeminnow or razorback sucker.

7.1.3.2 Maintenance

Maintenance conducted by APS and PNM along their transmission lines includes vegetation management, maintenance of towers, and periodic replacement of electrical components. It may also include emergency work to address threats to the lines integrity or performance. Emergency conditions are addressed immediately.

All maintenance work is subject to APS' And PNM's environmental screening programs, Both programs require all transmission maintenance work be screened for compliance-related environmental issues. PNM's program relies on end-to-end biological and cultural surveys, while APS's plan relies on habitat modeling followed by ground truthing in sensitive areas. Ground-disturbing work in the vicinity of a known cultural or biological resource requires specific monitoring or avoidance stipulations and procedures and land managing agencies are consulted to determine the best course of action to protect the integrity of the resource while conducting the necessary maintenance.

Vegetation management is performed in accordance with PNM's Vegetation Management Plan and may include manual cutting, mechanical clearing, and use of herbicides. Vegetation maintenance usually occurs every 4 to 5 years in pinyon-juniper and forested areas and every 2 to 3 years in riparian areas. PNM's Transmission Vegetation Management Plan will be replaced by a new document compliant with new NERC FAC-003-3 compliance requirements prior to its July 1, 2014, implementation.

Access roads are primarily unimproved two-track dirt roads. Access roads are repaired when roads and trails become impassable for maintenance activities. Access roads are also managed to control erosion and reduce conditions that will cause excessive rutting. Maintenance for the transmission line structures may include re-leveling pads in areas of uneven terrain to permit safe equipment setup, repair, replacement, or addition of structures or any of the associated equipment and wires, and treating the structures to prevent rot and extend their life span. This work would all be conducted outside of Colorado pikeminnow and razorback sucker habitat and designated critical habitat.

The only component of these activities that occurs within or adjacent to Colorado pikeminnow and razorback sucker habitat would be vegetation maintenance within the FCPP to San Juan ROW at the San Juan River. This vegetation is already subject to these maintenance activities and would continue to be in the future. This activity would affect a small area of riparian vegetation within the ROW. As such it would not affect Colorado pikeminnow or razorback sucker and would have a discountable effect on the habitat for these species.

7.2 Southwestern Willow Flycatcher and Yellow-Billed Cuckoo

No designated critical habitat for southwestern willow flycatcher occurs within the Action Area. Critical habitat has not been designated for yellow-billed cuckoo. Therefore, no effect would occur to designated critical habitat for these species.

7.2.1 Navajo Mine

7.2.1.1 Habitat Disturbance and Fragmentation

No southwestern willow flycatcher or yellow-billed cuckoo nesting habitat occurs within the Navajo Mine or Pinabete Permit Area. Small patches of poor quality riparian vegetation, associated with stock ponds, occur within the Pinabete Permit Area. Presently the Pinabete Permit Area supports poor quality potential stopover habitat comprised of fragmented riparian vegetation and small ponds, which could be subject to removal and reclamation. No potential nesting habitat is present. No southwestern willow flycatchers or yellow-billed cuckoo have been documented in the area (BNCC 2012b). Therefore, it is concluded that any loss of this habitat would represent a minor temporary disturbance to poor quality potential stopover habitat and would not result in an adverse effect to these species. Furthermore, continued mining and reclamation within the Navajo Mine would not result in an adverse effect to these species.

7.2.1.2 Hydrology

Minor alterations to the hydrology within the Navajo Mine and Pinabete Permit Area are expected to occur as a direct result of mining. These changes would result in changes in runoff patterns, which could result in some disturbance of riparian habitat as discussed in Section 7.1.1.1. The hydrology would be restored after mining is completed and the area is restored. These minor alterations to hydrology are expected to have a minor temporary disturbance to poor quality stopover habitat. No southwestern willow flycatchers or yellow-billed cuckoo have been observed in the Navajo Mine or Pinabete Permit Area, and the mine area does not provide any suitable nesting habitat for these species. No adverse effects to these species are expected to occur as a result of continued operation of the Navajo Mine or hydrologic alteration of the Pinabete Permit Area.

7.2.2 Four Corners Power Plant

7.2.2.1 Plant Operations and Maintenance

No southwestern willow flycatcher or yellow-billed cuckoo habitat occurs within the FCPP area. No effects to these species are expected to occur as a result of on-going operations and maintenance of the existing facilities. Stopover habitat for these species around Morgan Lake would be unaffected as long as Morgan Lake continues to be part of normal FCPP operations. Continued operation and maintenance of the FCPP are not expected to result in adverse effects to these species.

7.2.2.2 Ash Disposal Areas

Approximately 85 acres of potential, but poor quality, habitat for southwestern willow flycatcher and yellow-billed cuckoo occurs within the DFADA survey area. This habitat includes suitable, but poor quality, migratory stopover habitat in the ephemeral drainages located in the southern portion of the ash disposal action area, in areas just east of the Chaco River, and in the dense salt cedar stands located at the base of the existing Ash Disposal Area. Portions of this poor quality habitat would be permanently removed as part of the Proposed Action. No southwestern willow flycatcher or yellow-billed cuckoo has been observed using this habitat. Because of the poor quality and limited quantity of this habitat and the lack of permanent water nearby, these areas do not support nesting of these species. The loss of a portion of this habitat could disturb some migratory individuals of these two species; however, other habitat of similar quality would continue to exist in the nearby area. Thus, this activity may have a minor effect on a few individual southwestern willow flycatcher or yellow-billed cuckoo.

7.2.2.3 Atmospheric Emissions

The ERAs reported that the Proposed Action (e.g., future emissions from the FCPP) would not result in harm to southwestern willow flycatcher and yellow-billed cuckoo. The ERAs reported that HQs based on 95% UCL EPCs were much less than 1 for exposures resulting from future FCPP emissions along the San Juan River within the Deposition Area and downstream into the San Juan River arm of Lake Powell. As shown in Tables 7-3 and 7-4, comparison of ERA results for both Morgan Lake and the San Juan River show that the contribution of the Proposed Action is very small relative to baseline conditions. These very small contributions would not measurably increase the existing risks associated with baseline conditions.

Table 7-3 ERA Results for Southwestern Willow Flycatcher and Yellow-Billed Cuckoo Exposure to Morgan Lake under Baseline Conditions and the Proposed Action

	Baseline Conditions			Proposed Action		
COPEC	Sediment Concentration (mg/kg dw)	Water Concentration (mg/L)	HQ	Sediment Concentration (mg/kg dw)	Water Concentration (mg/L)	HQ
Chromium	7.0	0.0030	2.3	0.00000093	0.000000049	0.00040
Copper	10	0.0045	2.9	0.00000073	0.000000021	0.00056
Lead	8.7	0.0076	16	0.000059	0.000000066	0.00021
Methylmercury	0.0024	0.000000037	2.6	0.000032	0.000000036	0.12
Selenium	0.35	0.0034	9.8	0.00000059	0.00000012	0.00034

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Table 7-4 ERA Results for Southwestern Willow Flycatcher and Yellow-Billed Cuckoo Exposure to San Juan River under Baseline Conditions and the Proposed Action

	Baseline Conditions			Proposed Action		
COPEC	Sediment Concentration (mg/kg dw)	Water Concentration (mg/L)	HQ	Sediment Concentration (mg/kg dw)	Water Concentration (mg/L)	HQ
Copper	11	0.028	1.5	0.00000092	0.000000026	0.00061
Lead	24	0.020	1.5	0.000015	0.000000017	0.000068
Mercury	0.0030-0.020	0.0000070-0.00020	0.65-6.6	0.0000021	0.00000000097–0.0000000029	0.00028 - 0.0044
Selenium	0.13	0.0010 – 0.0095	2.1 – 2.9	0.00000016	0.000000032 – 0.0000023	0.000092 – 0.0066

Note: ERA results for copper, lead, and methylmercury are applicable only to the San Juan River within the Deposition Area. ERA results for selenium reflect the range of baseline conditions for the San Juan River within the Deposition Area and downstream into the San Juan River arm of Lake Powell.

7.2.3 Transmission Lines

7.2.3.1 Inspection

Routine inspection of the APS or PNM transmission lines would have no effect on southwestern willow flycatcher or yellow-billed cuckoo as no ground disturbance would occur.

7.2.3.2 Maintenance

Maintenance activities within both the APS and PNM transmission ROWs would entail the continued management of vegetation adjacent to the rivers, washes, and riparian habitats. These ROWs were cleared when the transmission lines were originally constructed and are maintained to prevent the establishment of large woody vegetation. Expected maintenance activities include the trimming or removal of trees or large shrubs within the ROW over the life of the transmission lines. Vegetation management is not expected to result in the loss or conversion of existing riparian habitats, as woody vegetation within the ROWs has been managed since the construction of the transmission lines. Both APS and PNM have prepared and follow conservation measures prescribed in their respective Wildlife Management Plans to reduce impacts to nesting avian species. Marginal migratory stopover habitat for southwestern willow flycatcher was documented along the APS transmission lines. No yellow-billed cuckoo habitat occurs along the APS transmission lines. Maintenance activities within the APS ROW would follow prescribed Standard Conservation Measures to reduce impacts to wildlife resources and to ensure that maintenance activities are compliant with state and federal regulations. These measures include various impact reduction measures, nest avoidance, pre-maintenance nest surveys, and measures specific to reduce impacts to migrating and nesting southwestern willow flycatchers. Given that these conservation measures include avoidance of riparian habitats identified as southwestern willow flycatcher habitat during the active migration and breeding season (April 15 through August 15), maintenance activities associated with the APS transmission lines would have no effect on this species. Maintenance activities within the PNM transmission ROW is not expected to result in the loss or conversion of existing riparian habitats as the transmission structures adjacent to the San Juan and Rio Puerco rivers are located above and outside of the riparian corridors. Maintenance activities near the San Juan or Rio Puerco rivers would be conducted in accordance with the stipulations resulting from environmental screening and Avian Protection Plan, eliminating any disturbance during these species' critical life stages. Therefore, these activities are not expected to affect these species.

7.3 California Condor

The Project Area is located at the extreme eastern edge of this species range and is expected to be used only on rare occasion during long-range reconnaissance flights by members of the Vermillion Cliffs population. Portions of the Action Area along the APS transmission lines was identified as suitable nesting and foraging habitat as a result of the AECOM habitat modeling effort (AECOM 2013d). No other areas within the Action Area contain suitable nesting habitat for this species.

7.3.1 Navajo Mine

7.3.1.1 Habitat Disturbance and Fragmentation

No California condor nesting habitat occurs within the Navajo Mine or Pinabete Permit Area; the Proposed Action would not result in habitat disturbance or fragmentation. Foraging could occur, but represents a very small percentage of this species range, and the Project Area is located on the extreme eastern edge of this species' range; therefore, this occurrence would be rare. Furthermore, big game occurs in small numbers in the Navajo Mine and Pinabete Permit Area, making these areas less attractive as a foraging location. Therefore, no effect to this species is expected from operations at Navajo Mine.

7.3.2 Four Corners Power Plant

7.3.2.1 Plant Operations and Maintenance

No California condor habitat occurs within the FCPP vicinity; plant operations and maintenance activities would not result in negative effects to this species. Therefore, FCPP operations are expected to have no effect on California condor.

7.3.2.2 Ash Disposal Areas

No California condor habitat occurs within the ash disposal facility vicinity; construction and operation of the ash disposal areas would not result in negative effects to this species. Therefore, the construction of the DFADA is expected to have no effect on California condor.

7.3.2.3 Atmospheric Emissions

California condor would be expected to feed in the Deposition Area only on very rare occasions, if at all. Any food consumed from within the area would represent a very small proportion of the bird's overall diet. As a result, the effect of atmospheric emissions on this species are discountable.

7.3.3 Transmission Lines

California condor nesting habitat was identified along portions of the APS transmission lines, but represents a very small percentage of this species overall range. No California condor nesting habitat was identified within the vicinity of the PNM transmission lines. This species may occur as a foraging visitor during long-range reconnaissance flights, but is unlikely to occur as a regular visitor as the Action Area is located on the extreme eastern end of this species range. The continued use of electrical transmission towers and lines could increase the long-term potential for condor line strikes/collision. However, the likelihood of this potential effect occurring is minimal given that the species occurrence in these areas would be very limited. This potential would remain unchanged relative to baseline conditions. Neither APS nor PNM avian mortality data have documented mortalities associated with this species (APS 2012c, PNM 2014).

The APS and PNM high-voltage transmission lines are constructed in compliance with National Electric Safety Code and internal engineering standards, and meet the APLIC-recommended design features to reduce risks of raptor electrocutions. By design, the conductor separation for the APS and PNM line voltages is in excess of 12 feet, larger than the wingspan of a California condor. Based on the mortality reports and transmission lines conductor configuration and spacing, very little to no risk of electrocution to California condors exists. It is concluded that the Project is unlikely to affect this species.

7.3.3.1 Inspection

Routine inspection of the APS or PNM transmission lines would have no effect on California condor as no disturbance to this species' habitat would occur.

7.3.3.2 Maintenance

Routine maintenance of the APS or PNM transmission lines would have no effect on California condor as no disturbance to this species' habitat would occur.

7.4 Mexican Spotted Owl

The Project Area is located within the known range of this species; however, no habitat capable of supporting this species occurs, nor has this species been identified within the Action or Deposition areas. Portions of the Action Area along the APS transmission lines were identified as suitable habitat as a result of the AECOM 2013 habitat modeling effort (AECOM 2013d); however, this habitat occurs outside the ROW.

7.4.1 Navajo Mine

7.4.1.1 Habitat Disturbance and Fragmentation

No Mexican spotted owl nesting habitat occurs within the Navajo Mine or Pinabete Permit Area; the Proposed Action would not result in habitat disturbance or fragmentation. Therefore, no effect to this species is expected from operations at Navajo Mine.

7.4.2 Four Corners Power Plant

7.4.2.1 Plant Operations and Maintenance

No Mexican spotted owl habitat occurs within the FCPP vicinity; plant operations and maintenance activities would not result in negative effects to this species. Therefore, FCPP operations are expected to have no effect on Mexican spotted owl.

7.4.2.2 Ash Disposal Areas

No Mexican spotted owl habitat occurs within the ash disposal facility vicinity; construction and operation of the ash disposal areas would not result in negative effects to this species. Therefore, the construction of the DFADA is expected to have no effect on Mexican spotted owl.

7.4.2.3 Atmospheric Emissions

Potentially suitable habitat for Mexican spotted owl has been identified within the Deposition Area (AECOM 2013d). The Deposition Area ERA indicates that no HQs greater than 1 would occur under baseline conditions. The additional contributions from atmospheric deposition over the duration of the Proposed Action would not result in HQs for any COPEC exceeding 1. Therefore, atmospheric deposition of COPECs from the Proposed Action would not affect Mexican spotted owls.

7.4.3 Transmission Lines

Mexican spotted owl habitat was identified adjacent to portions of the APS transmission lines. No Mexican spotted owl habitat was identified within the vicinity of the PNM transmission lines. This species may occur as a foraging or migrating visitor within the APS transmission lines, but is unlikely to nest within the ROW as no nesting habitat occurs within the ROW. The continued use of electrical transmission towers and lines could increase the long-term potential for Mexican spotted owl line strikes/collision. However, the likelihood of this potential effect occurring is minimal given that the species occurrence in these areas has never been documented. This risk would be the same as it is under baseline conditions. Neither APS nor PNM avian mortality data have documented mortalities associated with this species.

The APS high-voltage transmission lines are constructed in compliance with National Electric Safety Code and internal engineering standards, and meet the APLIC-recommended design features to reduce risks of raptor electrocutions. By design, the conductor separation for the APS and PNM line voltages is in excess of 12 feet, larger than the wingspan of a Mexican spotted owl. Based on the mortality reports and transmission lines conductor configuration and spacing, no risk of electrocution to Mexican spotted owls exists. Additionally, as a part of on-going APS and PNM avian and wildlife management plans, areas identified as a potential risk to avian species would be addressed as they are identified, Repairs or re-configuration of existing infrastructure presenting risks to avian species would be completed as part of these plans It is concluded that the Project is unlikely to affect this species.

7.4.3.1 Inspection

Routine inspection of the APS or PNM transmission lines would have no effect on Mexican spotted owl as no disturbance to this species' habitat would occur.

7.4.3.2 Maintenance

Routine maintenance of the APS or PNM transmission lines would have no effect on Mexican spotted owl as no disturbance to this species' habitat would occur.

7.5 Mancos Milk-Vetch

7.5.1 Navajo Mine

No Mancos milk-vetch populations or suitable habitat are located within or near where proposed construction or mining activities would occur. No effect to this species would result from mining activities.

7.5.2 Four Corners Power Plant

7.5.2.1 Plant Operations and Maintenance

No Mancos milk-vetch populations are located within or near FCPP so no direct effect would occur to populations within the plant area.

7.5.2.2 Ash Disposal Areas

No Mancos milk-vetch or suitable habitat for this species are located within or near where proposed construction or mining activities would occur. No effect to this species would result from activities in this area.

7.5.2.3 Atmospheric Emissions

The Deposition Area ERA reported that the Proposed Action (e.g., future emissions from the FCPP) would not result in harm to Mancos milk-vetch based on maximum soil concentrations within Mancos milk-vetch habitat within the Deposition Area, as all HQs were reported to be less than 1. As shown in Table 7-5, comparison of ERA results for Mancos milk-vetch show that the contribution of the Proposed Action is very small relative to baseline conditions. These very small contributions would not measurably increase the existing risks associated with baseline conditions.

Table 7-5 ERA Results for Mancos Milk-Vetch Exposure to Baseline Soil Conditions and the Proposed Action

COPEC	Baseline Conditions		Proposed Action	
	Soil Concentration (mg/kg dw)	Hazard Quotient	Soil Concentration (mg/kg dw)	Hazard Quotient
Boron	8.8	18	0.00015	0.00030
Chromium	15	15	0.00042	0.00042
Vanadium	25	13	0.0031	0.0015

7.5.3 Transmission Lines

7.5.3.1 Inspection

The continued operation of the transmission lines and performance of required inspection activities as previously authorized, along with associated BMPs, would minimize the effects of inspection activities. Aerial and ground inspections would not affect Mancos milk-vetch. Transmission line areas have been surveyed for this species and areas of suitable habitat and known populations have been mapped. Crews would receive environmental training to recognize the species. Inspection vehicles and crews will follow existing BMPs, including keeping vehicles on existing roads and traveling on foot to access areas that cannot be inspected from the roads. With these measures, no effect to Mancos milk-vetch would occur.

7.5.3.2 Maintenance

Maintenance activities including vegetation removal, and replacement of equipment along the rows would be conducted in accordance with existing vegetation management plans, environmental screening programs, and BMPs for such maintenance. These measures minimize the potential for maintenance activities to affect Mancos milk-vetch. Larger-scale maintenance activities that are not considered routine maintenance or have been previously authorized would be subject to separate consultation with the applicable land managing agency and USFWS. With the implementation of the BMPs, transmission line maintenance activities may affect, but are not likely to adversely affect Mancos milk-vetch.

7.6 Mesa Verde Cactus

7.6.1 Navajo Mine

No Mesa Verde populations or suitable habitat are located within or near where proposed construction or mining activities would occur. No effect to this species would result from mining activities.

7.6.2 Four Corners Power Plant

7.6.2.1 Plant Operations and Maintenance

No Mesa Verde populations or suitable habitat are located within or near where plant operations or maintenance activities would occur. No physical effect to this species would result from ongoing operations and maintenance activities in the FCPP area.

7.6.2.2 Ash Disposal Areas

Approximately 204 acres of potential habitat for the species would be permanently lost during the construction of the DFADA. Focused surveys of this area conducted in 2012 during the appropriate season for blooming did not find any plants occupying this habitat, nor do any historical records exist of Mesa Verde cactus in this area. Therefore, this action is not anticipated to affect the population of the species. This action would affect a limited portion of the species range and, therefore, is not likely to affect the species viability.

7.6.2.3 Atmospheric Emissions

The Deposition Area ERA reported that the Proposed Action (e.g., future emissions from the FCPP) would not result in harm to Mesa Verde cactus based on maximum soil concentrations within Mesa Verde cactus habitat within the Deposition Area, as all HQs were reported to be less than one. As shown in Table 7-6, comparison of ERA results for Mesa Verde cactus show that the contribution of the Proposed Action is very small relative to baseline conditions. These very small contributions would not measurably increase the existing risks associated with baseline conditions.

Table 7-6 ERA Results for Mesa Verde Cactus Exposure to Baseline Soil Conditions and the Proposed Action

COPEC	Baseline Conditions		Proposed Action	
	Soil Concentration (mg/kg dw)	Hazard Quotient	Soil Concentration (mg/kg dw)	Hazard Quotient
Boron	19	37	0.00015	0.00030
Chromium	17	17	0.00042	0.00042
Molybdenum	3.0	1.5	0.000023	0.000011
Selenium	1.7	3.3	0.000000059	0.00000011
Vanadium	35	18	0.0031	0.0015

7.6.3 Transmission Lines

7.6.3.1 Inspection

The continued operation of the transmission lines and performance of required inspection activities as previously authorized, along with associated BMPs, will minimize the effects of inspection activities. Aerial and ground inspections would not affect Mesa Verde cactus. Transmission line ROW areas have been surveyed for this species and areas of suitable habitat and known populations have been mapped. Crews will receive environmental training to recognize the species. Inspection vehicles and crews will follow existing BMPs, including keeping vehicles on existing roads and traveling on foot to access areas that cannot be inspected from the roads. With these measures, no effects to Mesa Verde cactus are anticipated.

7.6.3.2 Maintenance

The surveys completed by APS in April 2012 identified limited potential habitat for this species in the survey area. The habitat identification was determined based on evaluation of soil characteristics and vegetation community types found in the survey area. APS biologists completed presence/absence pedestrian surveys for this species in suitable habitat during the blooming period and no Mesa Verde cactus was recorded.

Potential habitat for Mesa Verde cactus along the PNM ROWs occurred along two segments of the FCPP to San Juan Generating Station transmission line corridor between poles (Marron and Associates 2012a). Four Mesa Verde cactus population sites were found scattered between structures FC13-18 during surveys conducted in April 2013 (Marron and Associates 2012b, 2013). Effects to these plants will be avoided through the following: any construction around pole FC17 shall be concentrated on the north, east, and south sides of this pole. No activity to the west of pole FC17 is authorized. Additionally, a line of sediment control material shall be placed immediately west of pole FC17 and 20-meters south of the pole during construction. Any construction around pole FC18 shall be concentrated on the eastern, southern, or western side of this pole. Additionally, a line of sediment control material will be placed on an east-west axis at a distance of 10 meters north of pole FC18 during construction.

Maintenance activities including vegetation removal and replacement of equipment along the ROWs will be conducted in accordance with existing vegetation management plans, environmental screening programs, and BMPs for such maintenance. These measures will greatly reduce the potential for maintenance activities to affect Mesa Verde cactus.

Larger-scale maintenance activities that are not considered routine maintenance or have been previously authorized would be subject to separate consultation with the applicable land managing agency and USFWS. With the implementation of the BMPs, transmission line maintenance activities may affect, but are not likely to adversely affect Mesa Verde cactus.

7.7 Fickeisen plains Cactus

7.7.1 Navajo Mine

No Fickeisen plains cactus populations or suitable habitat are located within or near where proposed construction or mining activities would occur. No effect to this species would result from mining activities.

7.7.2 Four Corners Power Plant

7.7.2.1 Plant Operations and Maintenance

No Fickeisen plains cactus populations or suitable habitat are located within or near where plant operations or maintenance activities would occur. No effect to this species would result from ongoing operations and maintenance activities in the FCPP area.

7.7.2.2 Ash Disposal Areas

No Fickeisen plains cactus populations or suitable habitat are located within or near the DFADA. No effect to this species would result from ongoing operations and maintenance activities in the DFADA area.

7.7.2.3 Atmospheric Emissions

No known populations or suitable habitat for Fickeisen plains cactus occurs within the Deposition Area so no effect would occur to this species from atmospheric deposition from FCPP.

7.7.3 Transmission Lines

7.7.3.1 Inspection

The continued operation of the transmission lines and performance of required inspection activities as previously authorized, along with associated BMPs, will minimize the effects of inspection activities. Aerial and ground inspections would not affect Fickeisen plains cactus. Transmission line ROW areas with suitable habitat along the 500-kV line have been surveyed for this species and areas of low and moderate quality, suitable habitat have been mapped. Crews will receive environmental training to recognize the species. Inspection vehicles and crews will follow existing BMPs, including keeping vehicles on existing roads and traveling on foot to access areas that cannot be inspected from the roads. With these measures, no effects to Fickeisen plains cactus are anticipated from transmission line inspections.

7.7.3.2 Maintenance

The surveys completed by APS in April 2012 identified limited low to moderate quality potential habitat for this species in the survey area along the 500-kV line. The habitat identification was determined based on evaluation of soil characteristics and vegetation community types found in the survey area. APS biologists completed presence/absence pedestrian surveys for this species in suitable habitat during the blooming period and no cactus was recorded.

Maintenance activities including vegetation removal and replacement of equipment along the 500-kV ROW will be conducted in accordance with existing vegetation management plans, environmental screening programs, and BMPs for such maintenance. These measures will minimize the potential for maintenance activities to affect Fickeisen plains cactus or their potential habitat. With the implementation of the BMPs, transmission line maintenance activities may affect, but are not likely to adversely affect Fickeisen plains cactus.

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8 Cumulative Effects

Cumulative effects include the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future federal actions that are unrelated to the Proposed Action are not considered in the cumulative effects section because they would require separate consultation pursuant to ESA Section 7.

8.1 Colorado Pikeminnow and Razorback Sucker and their Critical Habitat

8.1.1 Future Water Depletions

Future water depletions and diversions from the San Juan River Basin that do not have a federal nexus and, therefore, have not completed Section 7 consultation would be considered cumulative effects. Most of these depletions are accounted for in the consultation for Navajo Dam Operations (Reclamation 2006; USFWS 2006) and are, therefore, considered in meeting the San Juan River Flow Recommendations. No new water rights can be issued, as the basin is fully appropriated; however, some of the existing water rights are not being completely utilized at this time. As these water rights are more fully utilized, Navajo Dam operations will become more constrained and Reclamation would have less flexibility in to meet the flow recommendations (USFWS 2006), which would reduce river flow and decrease available habitat for Colorado pikeminnow and razorback sucker. Irrigation ditches and canals below Navajo Dam could entrain pikeminnow and razorback sucker: Citizens, Hammond, Fruitland, San Juan Generating Station, Jewett Ditch, and Hogback (USFWS 2006, 2009).

8.1.2 Floodplain Development

Increases in development and urbanization in the historic floodplain can result in reduced peak flows because of the flooding threat (USFWS 2006). Development in the floodplain makes it more difficult to transport large quantities of water that would overbank and create low-velocity habitats that razorback sucker and pikeminnow need for their various life-history stages (USFWS 2006, 2009).

8.1.3 Water Contamination

Contamination from runoff (i.e., sewage treatment plants, feedlots, residential and agricultural development, and atmospheric deposition of contaminants) could affect water quality in the San Juan River. A decrease in water quality could adversely affect razorback sucker and pikeminnow and their critical habitat (USFWS 2006, 2009).

8.1.4 Non-Native Vegetation

Gradual change in floodplain vegetation from native riparian species to non-native species (i.e., Russian olive and salt cedar) could occur. This conversion could result in channel narrowing as these non-native species encroach upon the floodplain. Channel narrowing leads to a deeper channel with higher water velocity. Pikeminnow and razorback sucker larvae require low-velocity habitats for development. Therefore, less nursery habitat would be available for both species (USFWS 2006, 2009). However, these changes may be off-set by the activities of the SJWWII (2006) which has developed a strategic plan for removing non-native vegetation and replacing it with native species.

8.1.5 Recreation Use

Increased recreational use (boating, fishing, ORV use, and camping) in the San Juan River is expected to increase as the human population increases. Potential effects include angling pressure, non-point source pollution, increased fire heat, and for harassment of native fishes (USFWS 2006, 2009).

8.1.6 Non-Native Fish in Lake Powell

Non-native fish presence in Lake Powell (striped bass, walleye, and channel catfish) constitutes a future threat to Colorado pikeminnow and razorback sucker in the San Juan River. When the water elevation of Lake Powell is high enough to inundate a barrier created by a waterfall, striped bass, walleye, channel catfish, and other non-native fish species can enter the San Juan River (USFWS 2006, 2009).

8.2 Southwestern Willow Flycatcher and Yellow-Billed Cuckoo

Cumulative effects to southwestern willow flycatcher and yellow-billed cuckoo would result from human activities, wildfire, and climate change.

8.2.1 Habitat Loss or Modification to Habitat or Range

8.2.1.1 Increases in Development and Urbanization

Increases in development and urbanization in the historic floodplain would affect southwestern willow flycatcher and yellow-billed cuckoo by reducing peak flows because of the flooding threat. Development in the floodplain would make it more difficult, if not impossible, to transport large quantities of water that overbank and clear decadent vegetation, allow the seeds of some native riparian plants, such as cottonwood to germinate and create habitat for these species.

8.2.1.2 Increased Urban Use of Water

As described in Section 8.1.1 increased urban use of water, including municipal and private uses, would affect southwestern willow flycatcher and yellow-billed cuckoo by reducing river flow and decreasing water available for creation of new and maintenance of existing riparian habitats for these species.

8.2.1.3 Water Contamination

Contamination of the water from sources such as sewage treatment plants, runoff from small feed lots and dairies, and residential, industrial, and commercial development could adversely affect the flycatcher and yellow-billed cuckoo. A decrease in water quality and gradual changes in floodplain vegetation could adversely affect these species, their prey base, and their habitat.

8.2.1.4 Non-Native Vegetation Removal

The removal of non-native vegetation, such as salt cedar and Russian olive, can adversely affect the amount of available southwestern willow flycatcher and yellow-billed cuckoo habitat in the short term. In areas where non-native trees are removed and replaced with native vegetation as part of a restoration project, habitat may be created. Where phreatophyte removal is not followed by restoration, habitat for these species is lost. The SJWWII (2006) which has developed a strategic plan for removing non-native vegetation and replacing it with native species, which is anticipated to result in the creation of more suitable habitat for riparian dependent species.

8.2.1.5 Wildfire

Wildfires and wildfire suppression in riparian areas may have an adverse effect on southwestern willow flycatcher and yellow-billed cuckoo. Wildfires are a fairly common occurrence in riparian areas. The spread of the highly flammable salt cedar and drying of river areas due to river flow regulation, water diversion, lowering of groundwater tables, and other land practices are largely responsible for the increase in fuel loading along riparian areas. Wildfires have the potential to destroy flycatcher habitat.

8.3 California Condor

Cumulative effects to California condor would result from continued interaction with man, poisoning, genetic factors, and man-made structures.

8.3.1 Increases in Development and Urbanization

Increased loss or modification to this species habitat or range as a direct result of human activities increases the likelihood of this species further decline. Increases in urban and agricultural development, recreation, and energy development could affect California condor by reducing the amount of available foraging habitat.

8.3.2 Poisoning, Shooting, and Specimen Collection

Exposure of California condor to sources of lead could adversely affect this species. Sources of lead contamination include species that have been shot by lead ammunition either left behind in the field or animals shot and unable to be recovered. Lead fragments left behind in the shot animal could be consumed by California condor. Increased interaction with humans could adversely affect this species as a direct result of shooting deaths. Although data supporting the number of shooting deaths are inconclusive, this threat is listed as one of the major contributing range-wide factors affecting this species' continued existence (USFWS 2013c).

8.3.3 Power Line Collisions

Continued operation of existing power lines and construction of new power lines would adversely affect this species. California condor interactions with transmission and distribution lines have been identified as one of the major contributing factors negatively affecting this species over its entire range (Kiff et al. 1996; USFWS 2013c); however, it has been identified that a larger percentage of the deaths are directly associated with smaller distribution lines (APLIC 2006). While collisions with larger transmission lines are less likely to occur, the threat of collision still exists. As a result, both APS and PNM have implemented design standards and risk reduction measures to greatly reduce or eliminate this risk altogether. All transmission lines associated with the Proposed Action meet APLIC standards, as do the distribution lines at Navajo Mine. Both APS and PNM implement wildlife management plans designed specifically to reduce impacts associated avian powerline interaction. Regular evaluation of avian mortalities in the respective service areas would identify collision risks and implement risk reduction measures as they are identified. Collisions with power lines, although identified as rare and haphazard, will continue as a long-term threat to the continued success of this species.

8.4 Mexican Spotted Owl

Cumulative effects to Mexican spotted owl would result from human activities, wildfire, and climate change.

8.4.1 Habitat Loss or Modification to Habitat or Range

8.4.1.1 Increases in Development and Urbanization

Increased loss or modification to this species habitat or range as a direct result of human activities increases the likelihood of this species further decline. Increases in silviculture, recreation, and energy development would affect Mexican spotted owl by reducing the amount of available habitat and increase the risk of wildfire. Development and wildfire in these habitats were late successional forest habitat is present would remove suitable habitat for many years following habitat removal or modification. This loss or modification makes it difficult, if not impossible, to quickly create new habitats for this species.

8.4.1.2 Other Human Activities

Human activities may adversely affect Mexican spotted owl by removal or modification of the amount and suitability of existing forest habitat. These activities include increasing water pollution from non-point sources; habitat disturbance from recreational use, and removal of large woody debris.

8.4.2 Other Natural or Man-Made Factors

8.4.2.1 Population Density

The possibility of deleterious genetic problems, resulting from the species' low population size, would adversely affect this species viability over time throughout its range. Given this species' small genetic pool, minor losses of individuals could have a dramatic effect on this species' overall genetic diversity.

8.4.2.2 Wildfire

Wildfires and wildfire suppression in riparian areas would have an adverse effect on Mexican spotted owl, and is listed as one of the largest contributing factors to this species. Continued suppression management of wildfires in this species habitat increases the size and intensity of wildfires where and when they occur. These wildfires have the potential to destroy Mexican spotted owl habitat.

8.5 Mancos Milk-Vetch

The entire range of Mancos milk-vetch occurs within a region of intense oil and gas development and existing facilities are located within the species habitat (USFWS 20011c). Mancos milk-vetch plants were parked on, run over, and possibly killed by the oil and gas development operations on the Palmer Mesa (Roth 2007). In addition to oil and gas development, roads and transmission lines are associated with existing coal-fired generating stations. Eight of the New Mexico populations are a few miles west of the San Juan Generating Station. The Sleeping Rock population was disturbed by a power line and a portion of the population was destroyed by the construction of a tower (USFWS 2011c). Future development of these resources are likely to require federal government permits and other approvals. As such, these activities would not be considered cumulative.

Potential effects could result from loss of suitable habitat and modification of potential, but unoccupied, habitat. Human presence has the potential to disturb vegetation in the Action Area, particularly in areas where humans travel beyond the boundaries of established roads, corridors, ROWs, or facilities. Dormant seedbeds could be adversely affected by construction activities.

8.6 Mesa Verde Cactus

Threats to Mesa Verde cactus were well documented when the species was listed; these threats continue to be a source of mortality. Ladyman (2004) noted complete loss of plants in historical sites from oil field development, a housing subdivision, livestock damage, and agriculture. In Colorado, livestock trampling was noted as the primary source of mortality (CNAP 2005).

Energy and mineral development is extensive in the area occupied by Mesa Verde cactus. The development of the oil, gas, and coal resources has included the creation and expansion of roads, pipelines, power lines, and associated commercial and associated residential development.

Beyond the effects of the drought, the most significant effects to Mesa Verde cactus are the numerous continuous, small conversions of habitat to urban use in the Shiprock area and to home-site development in the more rural areas. These losses are individually small but could become cumulatively significant (USFWS 2011d).

ORV use is increasing as the population of the Navajo Nation and San Juan County, New Mexico, increases. Negative effects to Mesa Verde cactus and its habitat are evident in unauthorized roadways, trails, flattened and denuded landscape, and continually increasing sizes of such areas. ORV use was determined to be the greatest threat to the population at the time of listing.

Livestock compact the soil, eliminating potential Mesa Verde cactus growth or recovery (USFWS 2011d). Although the habitat that Mesa Verde cactus occupies would by most accounts be described as "barren," livestock grazing occurs across most of the occupied habitat. Nearly all surveys record some disturbance by livestock.

8.7 Fickeisen Plains Cactus

This cactus has very specific habitat requirements and is considered naturally rare (Benson 2014). The species is a narrow endemic restricted to Kaibab limestone-derived soils and seems to have low reproductive capacity, even during favorable weather conditions. Because of its rarity and disjunct occurrence, this cactus is vulnerable to depopulation by damage to areas where it occurs. Current threats include trampling by livestock, non-native invasive species, rodent and rabbit herbivory, drought, and climate change that exacerbate the effects of small population size (USFWS 2013e). Other threats include ORV use, disturbance from road maintenance, and collection.

Energy and mineral development in areas occupied by Fickeisen cactus may include the creation and expansion of roads, pipelines, power lines, and associated commercial and associated residential development. These activities may decrease habitat availability for this species.

ORV use can adversely affect Fickeisen plains cactus and its habitat, and are evident in unauthorized roadways, trails, flattened and denuded landscape, and continually increasing sizes of such areas.

Livestock compact the soil and may trample Fickeisen plains cactus, reducing their habitat and impacting their populations.

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9 Conclusions

9.1 Colorado Pikeminnow and Razorback Sucker

OSMRE concludes that the Proposed Action may affect and is likely to adversely affect Colorado pikeminnow, as a result of entrainment at the APS Weir, release of non-native fish from Morgan Lake into the San Juan River via No Name Wash and the Chaco River, and atmospheric emissions of contaminants, which are already present in watershed in quantities that may adversely affect the species.

OSMRE concludes that the Proposed Action may affect and is likely to adversely affect razorback sucker, as a result of entrainment at the APS Weir, release of non-native fish from Morgan Lake into the San Juan River via No Name Wash and the Chaco River, and atmospheric emissions of contaminants, which are already present in watershed in quantities that may adversely affect the species.

OSMRE concludes that the Proposed Action may adversely modify critical habitat for Colorado pikeminnow, through release of non-native fish from Morgan Lake into designated critical habitat for these species. The ongoing operation of the APS Weir, which lies within critical habitat for Colorado pikeminnow, would continue to impair passage for this species.

OSMRE concludes that the Proposed Action may adversely modify critical habitat for razorback sucker, through release of non-native fish from Morgan Lake into designated critical habitat for these species. The APS Weir lies upstream of critical habitat for razorback sucker and, therefore, would not adversely modify critical habitat for this species.

The operation of the intakes at the APS Weir may entrain larval and juvenile Colorado pikeminnow and razorback sucker, resulting in direct take. However the level of take, based on the proportion of flow diverted and the proportion of habitat above the intakes, is expected to be quite small, less than 1.8 percent of the population of larval Colorado pikeminnow, 2.5 to 5.1 percent of stocked juvenile Colorado pikeminnow, and 0.12 to 2 percent of larval razorback sucker. Stocked razorback sucker are too large to be entrained. No spawning has been documented to occur upstream of APS Weir by either species. This may be the result of cool temperatures resulting from cold water releases at Navajo Dam that persist downstream beyond Farmington. This indicates that this habitat would likely not be used to the same degree for spawning as habitats further downstream. Therefore, larval entrainment is likely to be less than the values reported above. Studies at other diversions in the Basin (Renfro et al. 2006) suggest much lower entrainment rates of Colorado pikeminnow, with 0.002 and 0.004 percent of recently stocked Colorado pikeminnow and no razorback sucker being entrained, and no razorback sucker being entrained. This also suggests that entrainment may be much less than that predicted by the proportion of flow diverted.

The release of non-native fish from Morgan Lake would contribute to the existing issues associated with non-native fish in the San Juan River. Non-native fish have been identified as a threat to both Colorado pikeminnow (USFWS 2002a) and razorback sucker (USFWS 2002b), and a non-native fish removal program is conducted by the SJRRIP to help reduce this threat.

As indicated by the ERAs, several COPECs are present under baseline conditions at levels that result in some risk to these species. Atmospheric emissions from FCPP were reduced substantially at the end of the baseline period due to the shutdown of Units 1, 2, and 3, but some emissions will continue to occur and add to this condition, although the amount of this contribution is anticipated to be minute and would not increase the effect on the species. In addition, it is likely that in the future, global sources of mercury and selenium may increase, increasing the deposition of these COPECs into the watershed. This increase in global emissions would increase the future mercury and selenium concentrations in the San Juan River and in fish tissues, impairing the survival and reproduction of the species.

Because of the impairment of fish passage at the APS Weir and potential release of non-native fish from Morgan Lake, it is concluded that the Proposed Action would adversely modify critical habitat for Colorado pikeminnow and razorback sucker. Continued emissions from FCPP would contribute to existing issues relating to the amount of mercury and selenium in fish in the San Juan River, and the amounts of these metals are anticipated to increase in the future based on anticipated trends in future mercury emissions from other sources. The Proposed Action would add to this adverse condition. Even though the Proposed Action would not be expected to contribute enough of these materials to reduce habitat quality in and of themselves, the cumulative amount of these metals would be expected to adversely modify critical habitat for Colorado pikeminnow and razorback sucker.

9.2 Southwestern Willow Flycatcher and Yellow-Billed Cuckoo

- OSMRE concludes that the Proposed Action may affect but is not likely to adversely affect southwest willow flycatcher under current conditions.
- OSMRE concludes that the Proposed Action may affect but is not likely to adversely affect yellow-billed cuckoo under current conditions.
- OSMRE concludes that the Proposed Action is not likely to adversely modify habitat southwest willow flycatcher as designated critical habitat does not occur in the Action Area.
- OSMRE concludes that the Proposed Action is not likely to adversely modify habitat for yellow-billed cuckoo, as critical habitat has not been designated for this species.

These determinations are based on the limited amount of marginal habitat that currently exists within the Action Area for southwestern willow flycatcher and yellow-billed cuckoo. This habitat is not suitable for nesting and provides marginally suitable stopover habitat for migrating southwest willow flycatcher, such that individuals would be expected to remain in the Action Area for less than 2 weeks. These species have been observed sporadically in the Action Area, with no observation of any nest.

However, based on the SJWWII (2006) strategic plan, suitable nesting and foraging habitat could develop for these species along the San Juan River over the term of the Proposed Action. As indicated by the ERAs, several COPECs developed using conservative assumptions are present under baseline conditions at levels that result in some risk to these species. Atmospheric emissions from FCPP will be reduced substantially due to the shutdown of Units 1, 2, and 3, but some emissions will continue to occur and add to this condition, although these contributions are expected to be so small as to be immeasurable. In addition, it is likely that in the future, global sources of mercury and selenium may increase, increasing the deposition of these COPECs into the watershed. This increase in global emissions would increase future mercury and selenium concentrations in the San Juan River and in birds utilizing the areas around the river, thus potentially impairing the survival and/or reproductive success of these species. These concentrations are expected to reach levels that could cause impaired survival of southwestern willow flycatcher and yellow-billed cuckoo fledglings.

OSMRE, therefore, concludes that the Proposed Action, in addition to baseline and anticipated future conditions, may affect, and is likely to adversely affect southwestern willow flycatcher and yellow-billed cuckoo in the future, through contribution of mercury and selenium to the environment, should these species begin to breed along the San Juan River.

9.3 California Condor

- OSMRE concludes that the Proposed Action may affect, but is not likely to adversely affect, California condor.

Critical habitat has been designated for California condor, but does not occur within the Action Area. Therefore, no effect on critical habitat would occur for this species.

California condor would only be anticipated to occur in the Action Area as an occasional visitor during long-range reconnaissance flights, as the nearest populations are 250 miles from the Action Area. Those occasional visitors have the potential to interact with the transmission lines associated with the Proposed Action. These transmission lines are designed according to APLIC standards and the spacing of the conductors is substantially greater than the wingspan of a California condor. Given the rarity with which this species occurs in the area and the design of the transmission lines, the likelihood of a line strike or electrocution is so small as to be discountable. Other activities associated with the Proposed Action would not affect California condor.

9.4 Mexican Spotted Owl

- OSMRE concludes that the Proposed Action may affect, but is not likely to adversely affect, Mexican spotted owl.
- Critical habitat has been designated for Mexican spotted owl, but does not occur within the Action Area. Therefore, no effect on critical habitat would occur for this species.

A limited amount of suitable habitat for Mexican spotted owl has been identified adjacent to the APS ROWs; some of this habitat falls within the Deposition Area. No Mexican spotted owl have been observed in the Action Area. Mexican spotted owl could be subject to some level of disturbance as a result of maintenance activities along the ROW, but BMPs are in place to minimize such effects. The ERAs found that no risk or effect from atmospheric emissions from the FCPP would occur to this species.

9.5 Mancos Milk-Vetch

- OSMRE concludes that the Proposed Action, in combination with baseline conditions and reasonably foreseeable future conditions, may affect, but is not likely to adversely affect, Mancos milk-vetch.
- Critical habitat has not been designated for Mancos milk-vetch; therefore, no effect on critical habitat would occur.

No Mancos milk-vetch populations or suitable habitat for this species are located within or near the footprint of Navajo Mine, Pinabete Permit Area, or the FCPP Lease Area, therefore no direct effects would occur to this species resulting from increased construction or mining activities or FCPP's continued operation. Therefore, these activities would not adversely affect this species.

While the ERAs suggest that effects from emissions could occur to Mancos milk-vetch, COPEC toxicological thresholds are for plants that are not closely related to Mancos milk-vetch and that live in much different climates and soils. Furthermore, the soils that Mancos milk-vetch is dependent upon have been documented to have elevated concentrations of some COPECs, indicating that Mancos milk-vetch is adapted to soils with higher metal concentrations. No information suggests that Mancos milk-vetch would be adversely affected by deposition of metals or other compounds from FCPP's emissions. Therefore, it is concluded that atmospheric emissions may effect, but would not adversely affect, this species.

One population of Mancos milk-vetch has been identified below and around APS's FCPP to Cholla line. The continued operation of the transmission lines and performance of required maintenance activities as previously authorized have a limited potential to take Mancos milk-vetch. This potential is eliminated through implementation of BMPs, including mapping locations of suitable habitat and known populations, worker environmental awareness training, keeping vehicles on existing roads where possible, avoiding use of herbicides in areas of occupied, suitable habitat, and preconstruction surveys prior to or on-site monitoring of ground disturbing activities within areas of suitable habitat.

9.6 Mesa Verde Cactus

- OSMRE concludes that the Proposed Action, in combination with baseline conditions and reasonably foreseeable future conditions, may affect, but is not likely to adversely affect, Mesa Verde cactus.
- Critical habitat has not been designated for Mesa Verde cactus. Therefore, no effect on critical habitat would occur.

No Mesa Verde cactus are known to occur within the Navajo Mine Lease Area or in the FCPP Lease Area. Approximately 204 acres of potentially suitable habitat was identified in the DFADA. Potentially suitable habitat for Mesa Verde cactus has been identified along portions of the APS and PNM transmission lines. No Mesa Verde cactus have been identified during focused surveys in these areas. A few individual Mesa Verde cacti have been observed on the PPNM FC line to San Juan Generating Station.

While the ERAs suggest that effects from FCPP's emissions could occur to Mesa Verde cactus, COPEC toxicological thresholds are for plants that are not closely related to Mesa Verde cactus and live in much different climates and soils. Furthermore, the soils that Mesa Verde cactus is dependent upon have been documented to have elevated concentrations of some COPECs, indicating that Mesa Verde cactus is adapted to soils with higher metal concentrations. No information suggests that Mesa Verde cactus would be adversely affected by deposition of metals or other compounds from FCPP's emissions.

The continued operation of the transmission lines and performance of required maintenance activities as previously authorized have the potential to result in take of Mesa Verde cactus. This potential is eliminated through implementation of BMPs, including mapping locations of suitable habitat and known populations, worker environmental awareness training, keeping vehicles on existing roads, avoiding use of herbicides in areas of suitable, occupied habitat, and avoiding known Mesa Verde cactus during ground-disturbing activities.

9.7 Fickeisen plains Cactus

- OSMRE concludes that the Proposed Action, in combination with baseline conditions and reasonably foreseeable future conditions, may affect, but is not likely to adversely affect, Fickeisen plains cactus.
- OSMRE concludes that the Proposed Action would not adversely modify critical habitat for Fickeisen plains cactus.

Low to moderate quality suitable habitat for this species has been identified along the extreme western end of the APS FCPP to Moenkopi Line. Focused surveys did not observe any individuals present.

The continued operation of the transmission lines and performance of required maintenance activities as previously authorized have little potential to result in take of Fickeisen plains cactus. This potential is eliminated through implementation of BMPs, including mapping locations of suitable habitat and known populations, worker environmental awareness training, keeping vehicles on existing roads where possible, avoiding use of herbicides in areas of occupied, suitable habitat, and preconstruction surveys prior to or on-site monitoring of ground disturbing activities within areas of suitable habitat.

10 Literature Cited

Abell, R. 1994. San Juan River Basin water quality contaminants review: Volume 1. Unpublished report prepared by the Museum of Southwestern Biology, University of New Mexico, for the San Juan River Basin Recovery Implementation Program. U.S. Fish and Wildlife Service, Albuquerque, NM.

AECOM. 2013a. Four Corners Power Plant and Navajo Mine Environmental Impact Statement NAAQS Modeling Study. Prepared for Arizona Public Service (APS).

AECOM. 2013b. Four Corners Power Plant and Navajo Mine Energy Project Ecological Risk Assessment. Prepared on behalf of Arizona Public Service (APS). October.

AECOM. 2013c. San Juan River Ecological Risk Assessment Conducted in Support of the Four Corners Power Plant and Navajo Mine Energy Project. Prepared on behalf of Arizona Public Service(APS). October.

AECOM. 2013d. Habitat Model and Biological Survey Results for the Arizona Public Service Four Corners Power Plant and associated Transmission Lines . Submitted to Arizona Public Service Co. Phoenix, AZ. April.

AECOM. 2013e. Special-Status Plant Species 2013 Survey Report – Selected Locations Along APS Transmission Line Rights-of-Way . Submitted to Arizona Public Service Co. Phoenix, AZ. June.

Arizona Game and Fish Department. 2014. California Condor Recovery. Website (http://www.azgfd.gov/w_c/california_condor.shtml) accessed February 19, 2014.

Arizona Public Service (APS). 2011. Data Submitted Voluntarily to Navajo Nation Environmental Protection Agency by Four Corners. Samples collected from December 2006 through January 2011.

Arizona Public Services (APS). 2012a. Stormwater Pollution Prevention Plan for Four Corners Power Plant. 30 May.

Arizona Public Services (APS). 2012b. Data Request Response. Arizona Public Services 20120612_U15 MSGD SWPPP FC 2012 Updated SWPPP; Arizona Public Services 20121119_4C Dust control Plan+Cover; Arizona Public Services Substation_SPCC_Plan_11-09-2011; Arizona Public Services 110216_SPCC_Plan; Arizona Public Services Chemical Inventory Tier II Report; Arizona Public Services Hazardous Waste Compliance Plan; Arizona Public Services Hazardous Materials Storage Areas; Arizona Public Services ENV-FC03-CMP-D3-3 Solid Waste Compliance Plan; Arizona Public Services ENV-FC03-CMP-D3-14 Universal Waste Compliance Plan; Arizona Public Services ENV-FC03-CMP-D3-16 Biohazardous & Medical Waste; Arizona Public Services ENV-FC03-CMP-D3-17 Chemical Management System; Arizona Public Services 4C Station Fire Plan; Arizona Public Services 4C NPDES Permit.

Arizona Public Services (APS). 2012c. APS Avian database. Unpublished database.

Arizona Public Services (APS). 2013. Groundwater Monitoring Data for FCPP. Provided via email to OSMRE.

Avian Power Line Interaction Committee. 2006. Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006. Edison Electric Institute, Avian Power Line Interaction Committee, and the California Energy Commission, Washington D.C. and Sacramento, California.

Beckon, W.N., and T.C. Maurer. 2008. Potential Effects of Selenium Contamination on Federally Listed Species Resulting from Delivery of Federal Water to the San Luis Unit. U.S. Fish and Wildlife Service, Sacramento, CA.

Beckvar, N., T.M. Dillon, L.B. Read. 2005. Approaches for Linking Whole-Body Tissue Residues of Mercury or DDT to Biological Effects Thresholds. Environ. Toxicol. Chem. 24(8): 2094–2105.

Benson, L.D. Fickeisen Hedgehog Cactus – NatureServe. Website (http://explorer.natureserve.org) accessed April 15, 2014.

Bertram, P.E., and A.S. Brooks. 1986. Kinetics of accumulation of selenium from food and water by fathead minnows. *Wat. Res*. 20: 877-884.

Bestgen, K.R., J.A. Hawkins, G.C. White, C.D. Walford, P. Badame, and L. Monroe. 2010. Population status of Colorado pikeminnow in the Green River Basin, Utah and Colorado, 2006–2008. Final Report of Colorado State University Larval Fish Laboratory to Upper Colorado River Endangered Fish Recovery Program, Denver, CO.

Bestgen, K.R., K.A. Zelasko, and G.C. White. 2012. Monitoring reproduction, recruitment, and population status of razorback suckers in the Upper Colorado River basin. Final Report. Upper Colorado River Endangered Fish Recovery Program, U.S. Fish and Wildlife Service, Denver, CO.

BHP Navajo Coal Company (BNCC). 2009. Navajo Mine Permit Application NM-0003F. September.

BHP Navajo Coal Company (BNCC). 2011a. Environmental Assessment Company Pre-2016 Mine Plan for Area III and Area IV North. OSMRE EA# NM-0003

BHP Navajo Coal Company (BNCC). 2011b. Area IV North Mine Plan significant permit revision application. Submitted to the Office of Surface Mining Reclamation and Enforcement. February.

BHP Navajo Coal Company (BNCC). 2012a. Pinabete Mine Plan SMCRA Permit Application Package. Submitted to the Office of Surface Mining Reclamation and Enforcement. March 30.

BHP Navajo Coal Company (BNCC). 2012b. Baseline Resource Report, Sensitive Species. June 2012.

BHP Navajo Coal Company (BNCC). 2012c. Data 121005. 2012. Response to September 2012 Data Request

BHP Navajo Coal Company (BNCC). 2012d. Report 130104 2012 Response to November 26, 2012 Data Request.

Bio-West 2005. Evaluation of the Need for Fish Passage at the Arizona Public Service and Fruitland Irrigation Diversion Structures. Final Report. Prepared for the SJRRIP. Grant Agreement No. 04-FG-40-2160 PR 948-1.

Blanchard, P.J., R.R. Roy, and T.F. O'Brien. 1993. Reconnaissance investigation of water quality, bottom sediment, and biota associated with irrigation drainage in the San Juan River area, San Juan County, northwestern New Mexico, 1990-91. U.S. Geologic Survey Water Resources Investigations Report 93-4065.

Bleisner, R. E. De La Hoz, and V. Lamarra. 2008. San Juan River Basin Recovery Implementation Program. Hydrology, Geomorphology and Habitat Studies. 2008 Annual Report. Prepared for the San Juan River Basin Recovery Implementation Program.

Brandenburg, W. H., M. A. Farrington, E. I Gilbert. 2012. Colorado pikeminnow and razorback sucker larval fish survey in the San Juan River during 2011. Final Report. Submitted to the San Juan River Basin Biology Committee, San Juan River Recovery Implementation Program. June 30.

Buhl, K.J., and S.J. Hamilton. 2000. The chronic toxicity of dietary and waterborne selenium to adult Colorado pikeminnow in a water quality simulating that in the San Juan River. Final Report prepared for the San Juan River Recovery Implementation Program Biology.

Bureau of Indian Affairs (BIA). 2008. Biological Assessment for the Desert Rock Energy Project. Prepared by Ecosphere Environmental Services, Durango, CO.

Bureau of Land Management (BLM). 2003a. Mesa Verde cactus investigation; Hogback ACEC. Unpublished document. New Mexico Bureau of Land Management, Farmington, New Mexico.

Bureau of Land Management (BLM), Farmington Field Office. 2003b. Farmington Proposed Resource Management Plan and Final Environmental Impact Statement, Farmington, New Mexico, Farmington, NM

Bureau of Reclamation (Reclamation). 2006. Final Environmental Impact Statement. Navajo Reservoir Operations. FES-0606. April.

Bureau of Reclamation. 2012. Navajo Unit Operations and Hydrology Overview. Presented at the SJRBRIP Annual Meeting, May 16, 2012.

China Council for International Cooperation on Environment and Development (CCICED). 2011. Special Policy Study of Mercury Management in China. CCICED 2011 Annual General Meeting.

Coles, J.J. 2003. Population Biology of *Sclerocactus mesae-verdae* (Boiss. et Davidson) Benson: 2003 Performance Report. Project no.: E-9-R-20. Unpublished report. Colorado Natural Areas Program - Plant Conservation Program, Denver.

Coles, J.J. 2004. Population biology of *Sclerocactus mesae-verdae* (Boiss. Et Davidson) Benson: 2004 Performance Report. Project number: E-9-R-20. Unpublished report. Colorado Natural Areas Program – Plant Conservation Program, Denver.

Colorado Natural Areas Program - Plant Conservation Program (CNAP). 2005. Population Biology of *Sclerocactus mesae-verdae* (Boiss. et Davidson) Benson: 2005 Performance Report. Project number: E-9-R-22. Denver, CO.

Colorado Natural Heritage Program. 2007. Element state rank report for *Astragalus humillimus*. Colorado State University, Fort Collins.

Department of Toxic Substances Control (DTSC). 2000. EcoNote 4. Use of Navy/U.S. Environmental Protection Agency (EPA) Region 9 Biological Technical Assistance Group (BTAG) Toxicity Reference Values (TRVs) for Ecological Risk Assessment. December 8.

Dillon, T, N. Beckvar, and J. Kern. 2010. Residue-based mercury dose-response in fish: an analysis using lethality-equivalent test endpoints. Environmental Toxicology and Chemistry 29(11): 2559-2565.

Dudley, R.K., and S.P. Platania. 2000. Downstream transport rates of passively drifting particles and larval Colorado pikeminnow in the San Juan River in 1999. Draft Report. San Juan River Basin Recovery Implementation Program, USFWS, Albuquerque, NM.

Duran, B.R., J.E. Davis, and E. Teller Sr. 2013. Endangered fish monitoring and non-native fish control in the Upper/Middle San Juan River 2012. Final Report. Submitted to the San Juan River Recovery Implementation Program. USFWS, New Mexico Fish and Wildlife Conservation Office. July 3.

Durst, S.L. and N.R. Franssen (2014) Movement and Growth of Juvenile Colorado Pikeminnows in the San Juan River, Colorado, New Mexico, and Utah, Transactions of the American Fisheries Society, 143:2, 519-527

Durst, S. L., M.K. Sogge, S.D. Stump, H.A. Walker, B.E. Kus, and S.J. Sterra. 2008. Southwestern Willow Flycatcher Breeding Site and Territory Summary.

Ecosphere Environmental Services, Inc. (Ecosphere). 2006. Presence/absence summary report, Mesa Verde cactus (*Sclerocactus mesae-verdae*), Mancos milk-vetch (*Astragalus humillimus*) and listed noxious weeds along Segment A of the proposed Navajo Transmission Line. Unpublished report prepared for EPG. July.

Ecosphere Environmental Services, Inc. (Ecoshpere). 2011. Biological Evaluation, Pre-2016 Mine Plan for Area IV North and Area III Navajo Mine. October.

Ecosphere Environmental Services, Inc. (Ecosphere). 2012a. Baseline Biological Survey, APS Four Corners Power Plant, Proposed Ash Disposal Area. Prepared for AECOM. June 2012

Ecosphere Environmental Services, Inc. (Ecosphere).2012b. Pinabete Permit Area: Threatened, Endangered, and Sensitive Flora and Fauna. Navajo Mine, San Juan County, New Mexico. Prepared for BHP-Billiton Navajo Coal Company. Fruitland, New Mexico. November 2012

Ecosphere Environmental Services, Inc. (Ecosphere). 2013. Pinabete Permit Area Biological Evaluation. Prepared for BHP Navajo Coal Company.

Efroymson, R.A, Will, M.E., and Suter II, G.W. 1997. Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision. Prepared for the U.S. Department of Energy. ES/ER/TM-126/R2.

Electrical Power Research Institute (EPRI) 2011. Multi-Pathway Human Health and Ecological Risk Assessment for a Model Coal-Fired Power Plant, Electric Power Research Institute Report 1024496, October.

Electrical Power Research Institute (EPRI). 2014. A Case Study Assessment of Trace Metal Atmospheric Emissions and Their Aquatic Impacts in the San Juan River Basin. Palo Alto, CA.

Esplain, E. 1995. Site Inspection Report. Arizona Public Service-Four Corners Power Plant. Submitted to EPA Region IX.

Fjeld, E., T.O. Haugen, and L.A. Vollestad. 1998. Permanent impairment in the feeding behavior of grayling (*Thymallus thymallus*) exposed to methylmercury during embryogenesis. *Sci. Total Environ.* 213: 247-254.

Friedmann, A.S., M.C. Watzinb, T. Brink-Johnsen, J.C. Leiter. 1996. Low Levels of Methylmercury Inhibit Growth and Gonadal Development in Juvenile Walleye (Stizostedion vitreum). *Aquatic Toxicol.* 35: 265-278.

Furr, D. W. 2012. Augmentation of Colorado Pikeminnow (*Ptychocheilus lucius*) in the San Juan River: 2011. Annual Report. Prepared for the San Juan River Basin Recovery Implementation Program.

Furr, D. W. 2013. San Juan River razorback sucker (*Xyrauchen texanus*) population augmentation: 2012 Annual Report. Prepared for the San Juan River Recovery Implementation Program. July 8.

GEI Consultants. 2009. Final Coal Ash Impoundment – Specific Site Assessment Report, Arizona Public Service. September.

Gerig, B., and B. Hines. 2013. Endangered fish monitoring and non-native fish control in the lower San Juan River 2012. Annual Report. Submitted to the San Juan River Recovery Implementation Program. Utah Division of Wildlife Resources, Moab Field Station, June 30.

Gilbert E.I., A.M. Monié, and K. Patten. 2012. Annual Report. Small-bodied fishes monitoring, San Juan River, September-October 2011. San Juan River Basin Recovery Implementation Program.

Grimes, R. APS. Email to M. Calle-OSMRE, dated March 4, 2014.

Hamilton, S.J. 1999. Hypothesis of historical effects from selenium on endangered fish in the Colorado River basin. Human and Ecological Risk Assessment 5:1153-1180.

Hamilton, S.J. 2004. Review of selenium toxicity in the aquatic food chain. *Sci. Tot. Environ*. 326: 1-31.

Hamilton, S.J., K.J. Buhl, N.L. Faerber, R.H. Wiedmyer, and F.A. Bullard. 1990. Toxicity of organic selenium in the diet of chinook salmon. *Environ. Toxicol. Chem*. 9: 347-358.

Hamilton, S.J., K.M. Holley, K.J. Buhl, and F.A. Bullard. 2005a. Selenium impacts on razorback sucker, Colorado River, Colorado, I: Adults. Ecotoxicology and Environmental Safety 61: 7-31.

Hartmann, A.M. 1978. Mercury feeding schedules: effects on accumulation, retention, and behavior in trout. *Trans. Am. Fish Soc.* 107: 369–375.

Heil, K.D., and J. M. Porter. 1994. Sclerocactus (Cactaceae): A Revision. *Yearbook of the Cactus and Succulent Society of America.* Haseltonia 2: 20-45.

Holden, P.B. 1999. Flow recommendations for the San Juan River. San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, NM.

Holden, P.B. 2000. Program evaluation report for the 7-year research period (1991–1997). San Juan River Basin Recovery Implementation Program, USFWS, Albuquerque, NM.

Holm, J., V. Palace, P. Siwik, G. Sterling, R. Evens, C. Baron, J. Werner, and K. Wautier. 2005. Developmental effects of bioaccumulated selenium in eggs and larvae of two salmonid species. *Environ. Toxicol. Chem.* 24(9): 2373-2381.

Johnson, M.J., J.A. Holmes, C. Calvo, I. Samuels, S. Krantz, and M.K. Sogge, 2007. Yellow-billed cuckoo distribution, abundance, and habitat use along the lower Colorado and tributaries, 2006 annual report. *U.S. Geological Survey Open-File Report* 2007-1097 . Available online at http://pubs.usgs.gov/of/2007/1097.

Keller-Bliesner Engineering and Ecosystems Research Institute. 1999. Navajo Indian Irrigation Project Biological Assessment. Prepared for the Bureau of Indian Affairs, Farmington, NM.

Kiff, L.F., R.I. Mesta, and M.P. Wallace. 1996. Recovery Plan for the California Condor (*Gymnogyps californianus*). April.

Ladyman, J. 2004 . Status assessment report for *Sclerocactus mesae-verdae* (Mesa Verde cactus). Prepared for the Navajo Natural Heritage Program, Window Rock, AZ. Available online at http://nnhp.navajofishandwildlife.org/docs_reps.htm.

Lemly, A.D. 1993. Guidelines for evaluating selenium data from aquatic monitoring and assessment studies. *Environmental Monitoring and Assessment* 28:83-100.

Lemly, A.D. 2002. Selenium assessment in aquatic ecosystems: a guide for hazard evaluation and water quality criteria. Springer-Verlag, New York, NY.

Lenart, M., G. Garfin, B. Colby, T. Swetnam, B. J. Morehouse, S. Doster, and H. Hartmann. 2007. Global warming in the southwest: projections, observations, and impacts. Climate Assessment for the Southwest, University of Arizona.

Los Alamos National Laboratory (LANL) 2012. Ecorisk Database (Release 3.1). Available at: http://www.lanl.gov/community-environment/environmental-stewardship/protection/eco-riskassessment.php

Lusk, J. 2010. Mercury (Hg) and selenium (Se) in Colorado pikeminnow and in razorback sucker from the San Juan River. USFWS, New Mexico Ecological Services presentation to SJRRIP, Biology Committee Meeting. January 13.

Maier, K.J., and A.W. Knight. 1994. Ecotoxicology of selenium in freshwater systems. *Reviews of Environmental Contamination and Toxicology* 134:31-48.

Marron and Associates. 2012a. Biological Evaluation, PNM Transmission Line FW Maintenance San Juan, McKinley, Sandoval Counties, New Mexico. (FCPP to Rio Puerco Sub Station). Prepared for Public Service Company of New Mexico. Albuquerque, N.

Marron and Associates. 2012b. PNM Transmission Line FC Maintenance Biological Evaluation, San Juan County, New Mexico (FCPP to San Juan Generation Station), Prepared for Public Service Company of New Mexico. Albuquerque, NM.

Marron and Associates. 2013. PNM Transmission Line FW Maintenance Biological Evaluation, Sandoval and Bernalillo Counties, New Mexico (Rio Puerco Sub Station to West Mesa Sub Station), Prepared for Public Service Company of New Mexico. Albuquerque, NM.

Miller, B. 2014. Personal communication to Larry Wise, Cardno, on March 18, 2014.

Morel, J. 2012. Public Service Company of New Mexico (PNM) Fish Passage Facility 2011 Annual Report. Prepared for the San Juan River Basin Recovery Implementation Program. July 2.

Morgan, W.S.G. 1979. Fish locomotor behavior patterns as a monitoring tool. *J. Water Pollut. Control Fed.* 51: 580–589.

Muldavin, E., K. Johnson, and P. Tonne. 2003. New Mexico biodiversity and extreme drought effects. Available online at http://www.seo.state.nm.us/DroughtTaskForce/NMDSummit-2003/EstebanMuldavin.pdf.

National Research Council (NRC). 2007. Colorado River Basin Management: Evaluating and Adjusting to Hydroclimatic Variability. National Academy Press, Washington, DC.

Natural Heritage New Mexico (NHNM). 1991. Natural Heritage New Mexico database. University of New Mexico Biology Department, Albuquerque, NM. Available online at http://nmnhp.unm.edu/query_bcd/query.html.

Navajo Natural Heritage Program (NNHP). 2011. Response to data request for the Four Corners Power Plant from S. Detsoi (NNHP Wildlife Tech.) to P. Lorenz (AECOM) on November 11, 2011.

Navajo Natural Heritage Program (NNHP). 2012a. Response to data request for the 500-kv and 345-kv power lines for the Four Corners Power Plant from S. Detsoi (NNHP Wildlife Tech.) to P. Lorenz (AECOM) on March 20, 2012.

Navajo Natural Heritage Program (NNHP). 2012b. Response to data request for the 10 km to 30 km buffer for the Four Corners Power Plant from S. Detsoi (NNHP Wildlife Tech.) to P. Lorenz (AECOM) on April 18, 2012.

New Mexico Partners in Flight. 2014. Yellow-billed Cuckoo (Coccyzus americanus).Website (http://www.nmpartnersinflight.org/yellowbilledcuckoo.html) viewed: February 17, 2014.

Office of Surface Mining Reclamation and Enforcement (OSMRE). 2012a. BNCC Area IV North Mine Plan Revision. Environmental Assessment. U.S. Department of the Interior. Available online at http://www.wrcc.osmre.gov/Current_Initiatives/Navajo_Mine/AreaIVN/Final-EA/Chapter3.pdf.

Office of Surface Mining Reclamation and Enforcement (OSMRE). 2012b. BNCC Area IV North Mine Plan Revision. Finding of No Significant Impact. U.S. Department of the Interior.

Office of Surface Mining, Reclamation and Enforcement (OSMRE). 2014. Four Corners Power Plant and Navajo Mine Energy Project Draft Environmental Impact Statement. Denver, CO

Osmundson, B.C., T.W. May, and D.B. Osmundson. 2000. Selenium concentrations in the Colorado pikeminnow (*Ptychocheilus lucius*): relationship with flows in the upper Colorado River. *Archives of Environmental Contamination and Toxicology* 38:479-485.

Osmundson, D. B., and S. C. Seal. 2009. Successful spawning by razorback sucker in the Gunnison and Colorado rivers, as evidenced by larval fish collections, 2002-2007. Final Report. U. S. Fish and Wildlife Service, Grand Junction, Colorado.

ED_004888_00071668-00210

Osmundson, D.B., and G. C. White. 2009. Population status and trends of Colorado pikeminnow of the upper Colorado River, 1991-2005. Final Report of U.S. Fish and Wildlife Service to Upper Colorado River Endangered Fish Recovery Program, Denver, CO.

Papadopoulos, S.S. & Associates, Inc. 2006. Coalbed Methane Stream Depletion Assessment Study-Northern San Juan Basin, Colorado. February. Accessed at: http://cogcc.state.co.us/Library/SanJuanBasin/CMSDA_Study.pdf

Public Service Company of New Mexico (PNM) 2014. Special Purpose – Salvage – Annual Reports (2003 to 2011) submitted to USFWS Migratory Bird Permit Office. PNM, Albuquerque, NM

Quartarone, F., and C. Young. 1995. Historical accounts of Upper Colorado River Basin endangered fish. Produced for the Information and Education Committee of the Recovery Program for Endangered Fish of the Upper Colorado River Basin.

Renfro L.E., S.P. Plantanis, and R.K. Dudley 2006. An assessment of fish entrainment in the Hogback Diversion Canal, San Juan River, New Mexico, 2004. Prepared for the San Juan River Basin Recovery Implementation Program. U.S. Bureau of Reclamation Contract No. 04-FG-2213.

Roth, D. 2004. Monitoring report, Mesa Verde cactus transplantation for BIA Route N57 – Cudei Rd, San Juan County, NM. Unpublished report. Navajo Natural Heritage Program, Department of Fish and Wildlife, Window Rock, AZ.

Roth, D. 2007. Memo to the file dated May 14, 2007. Disturbance of *Astragalus humillimus* EOR #6 by Plugging and Abandonment Operations at Palmer Mesa.

Roth, D. 2008a. Mancos milk-vetch (*Astragalus humillimus*) Trend/Status Assessment 2008. Navajo Natural Heritage Program, Department of Fish and Wildlife.

Roth, D. 2008b. Monitoring report: *Sclerocactus mesae-verdae* transplant project. Northern Navajo Fairgrounds, Shiprock, San Juan County, NM. Unpublished report. Navajo Natural Heritage Program, Department of Fish and Wildlife, Window Rock, AZ.

Ryden, D.W. 2012. Long-term Monitoring of Sub-adult and Adult Large-bodied Fishes in the San Juan River: 2010. Interim Progress Report (Final Report). Prepared for the Bureau of Reclamation, February 2.

Sample, B.E., D.M. Opresko, and G.W. Sutter II. 1996. Toxicological Benchmarks for Wildlife: 1996 Revision. Risk Assessment Program, Health Sciences Research Division, Oak Ridge National Laboratory, Oak Ridge, TN. Prepared for the U.S. Department of Energy, Office of Environmental Management. ES/ER/TM-86/R3. June.

San Juan Watershed Woody-Invasives Initiative (SJWWII). 2006. San Juan Watershed Woody-Invasives Initiative Strategic Plan.

Schleicher, B.M., and D. W. Ryden, 2013. Long-term Monitoring of Sub-adult and Adult Large-bodied Fishes in the San Juan River: 2012. Interim Progress Report (Final Report). Prepared for the Bureau of Reclamation. August 7.

Seager, R., M. Ting, I. Held, Y. Kushnir, J. Lu, G. Vecchi, H.-P. Huang, N. Harnik, A. Leetmaa, N-C. Lau, C. Li, J. Velez, and N. Naik. 2007. Model projections of an imminent transition to a more arid climate in southwest North America. *Science* 316:1181-1184.

Shacklette, H.T., and J.G. Boerngen. 1984. Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States. *U.S. Geological Survey Professional Paper* 1270.

Simpson, Z.R., and J.D. Lusk. 1999. Environmental Contaminants in Aquatic Plants, Invertebrates, and Fishes of the San Juan River Mainstem, 1990–1996. Prepared for the San Juan River Recovery Implementation Program. USFWS New Mexico Ecological Services Field Office. October 26.

Sivinski, R. 2003. Mesa Verde cactus: an 18-year demographic summary of the Waterflow, New Mexico study plot. Unpublished report. New Mexico Forestry Division, Energy, Minerals, and Natural Resources Department, Santa Fe, NM.

Sivinski, R.C. 2008. Population studies of Mancos milk-vetch (*Astragalus humillimus*: Fabaceae) in San Juan County, New Mexico from 1988 to 2008. Section 6 E-23 Progress Report to U.S. Fish and Wildlife Service, Albuquerque, NM.

Sivinski, R.C., and P.C. Knight. 2001. Population characteristics of Mancos milk-vetch (*Astragalus humillimus*: Fabaceae) in San Juan County, New Mexico. *NM Naturalist Notes* 3(1):51-61.

Sogge, M.K., D. Ahlers, and S.J. Sferra. 2010. A Natural History Summary and Survey Protocol for the Southwestern Willow Flycatcher. *U.S. Geological Survey Techniques and Methods* 2A-10.

SWCA Environmental Consultants. 2012. Summary Report for the San Juan River Basin Recovery Implementation Program Habitat Monitoring Workshop. Prepared for U.S. Fish and Wildlife Service and Bureau of Reclamation.

Thomas, C.L., J.D. Lusk, R.S. Bristol, R.M. Wilson, and A.R. Shineman. 1997. Physical, chemical, and biological data for detailed study of irrigation drainage in the San Juan River area, New Mexico, 1993–1994, with supplemental data, 1991–1995. U.S. Geological Survey Open-File Report 97-249. Albuquerque, NM.

Thomas, C.L., R.M. Wilson, J.D. Lusk, R.S. Bristol, and A.R. Shineman. 1998. Detailed study of selenium and selected constituents in water, bottom sediment, soil, and biota associated with irrigation drainage in the San Juan River area, New Mexico, 1991–1995. U.S. Geological Survey Open-File Report 98-4213. Albuquerque, NM.

United Nations Environmental Programme (UNEP). 2013a. Global Mercury Assessment 2013: Sources, Emissions, Releases and Environmental Transport. UNEP Chemicals Branch, Geneva, Switzerland.

United Nations Environmental Programme (UNEP). 2013b. Adoption of the Minamata Convention on Mercury. Conference of Plenipotentiaries on the Minamata Convention on Mercury, Kumamoto, Japan. October 10-11, 2013.

United States Army Corps of Engineers (USACE). 2013. Draft Clean Water Act 404(b) Analysis.

United States Department of Energy (DOE). 2011. Natural Contamination from the Mancos Shale. LMS/S07480 ESL-RPT-2011-01. Doc. No. S07480. April.

United States Environmental Protection Agency (EPA). 1997a. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (Interim Final). Office of Solid Waste and Emergency Response, Office of Emergency and Remedial Response. EPA 540/R-97/006. June.

United States Environmental Protection Agency (EPA) 1997b. Mercury study report to Congress. Volume III: Fate and transport of mercury in the environment. EPA-452/R-97-005.

United States Environmental Protection Agency (EPA). 1998. Guidelines for Ecological Risk Assessment. Risk Assessment Forum. Washington, DC. EPA/630/R-95/002F. April.

United States Environmental Protection Agency (EPA). 2002. U.S. EPA Region 9 Biological Technical Assistance Group (BTAG) Recommended Toxicity Reference Values for Mammals. Revision Date 11/21/02.

United States Environmental Protection Agency (EPA). 2005a. Human Health Risk Assessment Protocol (HHRAP) for Hazardous Waste Combustion Facilities, Final. EPA 520-R-05-006. September.

United States Environmental Protection Agency (EPA). 2005b. Guidance for Developing Ecological Screening Levels, OSWER Directive 9285.7-55. March.

United States Environmental Protection Agency (EPA). 2005c. Ecological Soil Screening Levels for Lead. Interim Final. Washington, DC. OSWER Directive 9285.7- 70. March.

United States Environmental Protection Agency (EPA). 2005d. Regulatory Impact Analysis of the Final Clean Air Mercury Rule. EPA-425-R-05-003.

United States Environmental Protection Agency (EPA) 2007a Guidance for Developing Ecological Soil Screening Levels (Eco-SSLs). Attachment 4-1 Exposure Factors and Bioaccumulation Models for Derivation of Wildlife Eco-SSLs. OSWER Directive 9285.7-55. Revised April 2007.

United States Environmental Protection Agency (EPA). 2007b. Ecological Soil Screening Levels for Copper. Interim Final. Washington, DC. OSWER Directive 9285.7-68. February.

United States Environmental Protection Agency (EPA). 2007c. Ecological Soil Screening Levels for Selenium. Interim Final. Washington, DC. OSWER Directive 9285.7-72. July.

United States Environmental Protection Agency (EPA). 2008. Ecological Soil Screening Levels for Chromium. Interim Final. Washington, DC. OSWER Directive 9285.7-66. April.

United States Environmental Protection Agency (EPA). 2009a. US EPA Region 9 Biological Technical Assistance Group (BTAG) Recommended Toxicity Reference Values for Birds. Revision Date 02/24/09.

United States Environmental Protection Agency (EPA). 2009b. National Recommended Water Quality Criteria for Aquatic Life. United States Environmental Protection Agency. Available at: http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm

United States Environmental Protection Agency (EPA). 2010. Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses. Office of Research and Development, Duluth, MN. PB85-227049.

United States Environmental Protection Agency (EPA). 2011. Compilation of Air Pollution Emission Factors (AP-42), Fifth Edition (1995-2011). Accessed at: http://www.epa.gov/ttn/chief/ap42/.

United States Environmental Protection Agency (EPA). 2012a. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2011. Available online at http://epa.gov/climatechange/emissions/usinventoryreport.html.

United States Environmental Protection Agency (EPA). 2012b. National Emissions Inventory (NEI) Air Pollutant Emissions Trends Data. Available online at http://www.epa.gov/ttn/chief/trends/index.html.

United States Environmental Protection Agency (EPA). 2012c. Greenhouse Gas Emissions. Available online at http://www.epa.gov/climatechange/ghgemissions/.

United States Environmental Protection Agency (EPA). 2012d. Air Data – Air Quality System (AQS) Data Mart. Available online at http://www.epa.gov/airdata/.

United States Fish and Wildlife Services (USFWS). 1979. Endangered and threatened wildlife and plants; determination that *Sclerocactus mesae-verdae* is a threatened species. *Federal Register* 44-62472.

United States Fish and Wildlife Services (USFWS).1984. Mesa Verde Cactus (*Sclerocactus mesae-verdae*) Recovery Plan. Albuquerque, NM.

United States Fish and Wildlife Services (USFWS).1985. Endangered and threatened wildlife and plants; final rule to determine *Astragalus humillimus* to be endangered. *Federal Register* (50) 124 26568-26572.

United States Fish and Wildlife Services (USFWS).1989. Mancos Milk-Vetch (*Astragalus humillimus*) Recovery Plan. New Mexico Ecological Services Field Office, Albuquerque, NM.

United States Fish and Wildlife Service (USFWS) 2002a. Colorado Pikeminnow (*Ptychocheilus lucius*) Recovery Goals. Amendment and Supplement to the Colorado Squawfish Recovery Plan. Mountain-Prairie Region (6), Denver, CO.

United States Fish and Wildlife Service (USFWS). 2002b. Razorback Sucker (*Xyrauchen texanus*) Recovery Goals: Amendment and Supplement to the Razorback Sucker Recovery Plan. Mountain-Prairie Region (6), Denver, CO.

United States Fish and Wildlife Service (USFWS). 2002c. Southwestern Willow Flycatcher Recovery Plan. Albuquerque, NM.

United States Fish and Wildlife Service (USFWS). 2005. Methylmercury and Other Environmental Contaminants in Water and Fish Collected from Four Recreational Fishing Lakes on the Navajo Nation, 2004. New Mexico Ecological Services Field Office. Albuquerque, NM. July.

United States Fish and Wildlife Service (USFWS). 2006. Final Biological Opinion for Navajo Reservoir Operations, Colorado River Storage Project, Colorado-New Mexico-Utah. January 5.

United States Fish and Wildlife Services (USFWS). 2008. Mesa Verde cactus *Sclerocactus mesae-verdae* (Bossevain and C. Davidson) Draft 5-Year Review: Summary and Evaluation.

United States Fish and Wildlife Services (USFWS). 2009. Final Biological Opinion for the Navajo-Gallup Water Supply Project, U.S. Bureau of Reclamation, Durango, CO

United States Fish and Wildlife Service (USFWS). 2011a. Colorado pikeminnow (*Ptychocheilus lucius*): 5-Year Review: Summary and Evaluation. Upper Colorado River Endangered Fish Recovery Program, Denver, CO.

United States Fish and Wildlife Service (USFWS). 2011b. Species Assessment and Listing Priority Assignment Form for the Yellow-Billed Cuckoo.

United States Fish and Wildlife Service (USFWS) 2011c. Mancos milkvetch (Astragalus humillimus). 5 year review. USFWS New Mexico Ecological Services Office, Albuquerque.

United States Fish and Wildlife Service (USFWS). 2011d. Mesa Verde cactus *Sclerocactus mesae-verdae* (Bossevain and C. Davidson) Draft 5-Year Review: Summary and Evaluation.

United States Fish and Wildlife Service (USFWS) 2012a. Razorback sucker (*Xyrauchen texanus*): 5-Year Review: Summary and Evaluation. Upper Colorado River Endangered Fish Recovery Program, Denver, CO.

United States Fish and Wildlife Service. 2012b. Final Recovery Plan for the Mexican Spotted Owl (*Strix occidentalis lucida*), First Revision. Albuquerque, NM.

United States Fish and Wildlife Services (USFWS). 2013a. Endangered and Threatened Wildlife and Plants; Designation of Revised Critical Habitat for Southwestern Willow Flycatcher. *Federal Register* 78 FR 343 534.

United States Fish and Wildlife Services (USFWS). 2013b. Proposed Threatened Status for the Western Distinct Population Segment of the Yellow-Billed Cuckoo (Coccyzus americanus). 78 FR 78321

United States Fish and Wildlife Service (USFWS). 2013c. California Condor Recovery Program. May 31.

United States Fish and Wildlife Service. 2013d. Mexican Spotted Owl 5-Year Review. Arizona Ecological Field Services Office. Phoenix, AZ. August.

United States Fish and Wildlife Services (USFWS). 2013e. Fickeisen plains Cactus (*Pediocactus peeblesianus* var. *fickeiseniae*) General Species Information (last updated Dec 4, 2013). Southwest Region, Arizona Website (http://www.fws.gov/southwest/es/arizona/fickeisen.htm) accessed April 15,2014.

United States Fish and Wildlife Service. 2014. Species Profile, Mexican Spotted Owl (*Strix occidentalis lucida*). Available at http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B074#conservationPlans. Accessed April 18, 2014.

United States Geological Survey (USGS). 1990. Results of Sample Analysis of Heavy-Mineral Deposits in the Point Lookout Sandstone, Southwest Colorado and Northwest New Mexico. *Open File Report* 90-40.

United States Geological Survey (USGS). 2012. Geochemistry of soils in the U.S. from the PLUTO database. Reston, VA. Website (http://tin.er.usgs.gov/pluto/soil/) accessed July 30, 2012.

Upper Colorado River Endangered Fish Recovery Program (UCREFRP). 2014a. Colorado pikeminnow (*Ptychocheilus lucius*) Website (http://www.coloradoriverrecovery.org/general-information/the-fish/colorado-pikeminnow.html) accessed February 26, 2014.

Upper Colorado River Endangered Fish Recovery Program (UCREFRP). 2014b. Razorback sucker (*Xyrauchen texanus*) Website (http://www.coloradoriverrecovery.org/general-information/the-fish/razorback-sucker.html) accessed February 26, 2014.

URS. 2008. Ecological Risk Assessment for Threatened and Endangered Species. Desert Rock Energy Project. Prepared for Bureau of Indian Affairs. November.

Webber, H.M., and T.A. Haines. 2003. Mercury effects on predator avoidance behavior of a forage fish, golden shiner (*Notemigonus crysoleucas*). *Environ. Toxicol. Chem.* 22(7): 1556–1561.

Western Regional Climate Center. 2008. Historical climate information, Western U.S. Climate Historical Summaries, New Mexico, Shiprock, Monthly Total Precipitation. Available online at http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?nm8284.

Wilson, R.M., J.D. Lusk, S. Bristol, B. Waddell, and C. Wiens. 1995. Environmental contaminants in biota from the San Juan River and selected tributaries in Colorado, New Mexico, Utah. 1995 Annual progress report submitted to the San Juan River Recovery Implementation Program. U.S. Fish and Wildlife Service, Albuquerque, NM.

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FCPP and Navajo Mine Energy Project
Biological Assessment

APPENDIX

A

USFWS SPECIES LISTS FROM IPAC AND ARIZONA OFFICE WEBSITE

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New Mexico Ecological Services Field Office
2105 OSUNA ROAD NE
ALBUQUERQUE, NM 87113
PHONE: (505)346-2525 FAX: (505)346-2542
URL: www.fws.gov/southwest/es/NewMexico/

Consultation Tracking Number: 02ENNM00-2014-SLI-0064 January 23, 2014
Project Name: Four Corners Navajo Mine Energy Project

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project.

To Whom It May Concern:

Thank you for your recent request for information on federally listed species and important wildlife habitats that may occur in your project area. The U.S. Fish and Wildlife Service (Service) has responsibility for certain species of New Mexico wildlife under the Endangered Species Act (ESA) of 1973 as amended (16 USC 1531 et seq.), the Migratory Bird Treaty Act (MBTA) as amended (16 USC 701-715), and the Bald and Golden Eagle Protection Act (BGEPA) as amended (16 USC 668-668c). We are providing the following guidance to assist you in determining which federally imperiled species may or may not occur within your project area and to recommend some conservation measures that can be included in your project design.

FEDERALLY-LISTED SPECIES AND DESIGNATED CRITICAL HABITAT

Attached is a list of endangered, threatened, and proposed species that may occur in your project area. Your project area may not necessarily include all or any of these species. Under the ESA, it is the responsibility of the Federal action agency or its designated representative to determine if a proposed action "may affect" endangered, threatened, or proposed species, or designated critical habitat, and if so, to consult with the Service further. Similarly, it is the responsibility of the Federal action agency or project proponent, not the Service, to make "no effect" determinations. If you determine that your proposed action will have "no effect" on threatened or endangered species or their respective critical habitat, you do not need to seek concurrence with the Service. Nevertheless, it is a violation of Federal law to harm or harass any federally-listed threatened or endangered fish or wildlife species without the appropriate permit.

If you determine that your proposed action may affect federally-listed species, consultation with the Service will be necessary. Through the consultation process, we will analyze information contained in a biological assessment that you provide. If your proposed action is associated with Federal funding or permitting, consultation will occur with the Federal agency under section

7(a)(2) of the ESA. Otherwise, an incidental take permit pursuant to section 10(a)(1)(B) of the ESA (also known as a habitat conservation plan) is necessary to harm or harass federally listed threatened or endangered fish or wildlife species. In either case, there is no mechanism for authorizing incidental take "after-the-fact." For more information regarding formal consultation and HCPs, please see the Service’s Consultation Handbook and Habitat Conservation Plans at www.fws.gov/endangered/esa-library/index.html#consultations.

The scope of federally listed species compliance not only includes direct effects, but also any interrelated or interdependent project activities (e.g., equipment staging areas, offsite borrow material areas, or utility relocations) and any indirect or cumulative effects that may occur in the action area. The action area includes all areas to be affected, not merely the immediate area involved in the action. Large projects may have effects outside the immediate area to species not listed here that should be addressed. If your action area has suitable habitat for any of the attached species, we recommend that species-specific surveys be conducted during the flowering season for plants and at the appropriate time for wildlife to evaluate any possible project-related impacts.

Candidate Species and Other Sensitive Species

A list of candidate and other sensitive species in your area is also attached. Candidate species and other sensitive species are species that have no legal protection under the ESA, although we recommend that candidate and other sensitive species be included in your surveys and considered for planning purposes. The Service monitors the status of these species. If significant declines occur, these species could potentially be listed. Therefore, actions that may contribute to their decline should be avoided.

Lists of sensitive species including State-listed endangered and threatened species are compiled by New Mexico state agencies. These lists, along with species information, can be found at the following websites:

Biota Information System of New Mexico (BISON-M): www.bison-m.org

New Mexico State Forestry. The New Mexico Endangered Plant Program:
www.emnrd.state.nm.us/SFD/ForestMgt/Endangered.html

New Mexico Rare Plant Technical Council, New Mexico Rare Plants: nmrareplants.unm.edu

Natural Heritage New Mexico, online species database: nhnm.unm.edu

WETLANDS AND FLOODPLAINS

Under Executive Orders 11988 and 11990, Federal agencies are required to minimize the destruction, loss, or degradation of wetlands and floodplains, and preserve and enhance their natural and beneficial values. These habitats should be conserved through avoidance, or mitigated to ensure that there would be no net loss of wetlands function and value.

We encourage you to use the National Wetland Inventory (NWI) maps in conjunction with ground-truthing to identify wetlands occurring in your project area. The Service's NWI program website, www.fws.gov/wetlands/Data/Mapper.html integrates digital map data with other resource information. We also recommend you contact the U.S. Army Corps of Engineers for permitting requirements under section 404 of the Clean Water Act if your proposed action could impact floodplains or wetlands.

MIGRATORY BIRDS

The MBTA prohibits the taking of migratory birds, nests, and eggs, except as permitted by the Service's Migratory Bird Office. To minimize the likelihood of adverse impacts to migratory birds, we recommend construction activities occur outside the general bird nesting season from March through August, or that areas proposed for construction during the nesting season be surveyed, and when occupied, avoided until the young have fledged.

We recommend review of Birds of Conservation Concern at website www.fws.gov/migratorybirds/CurrentBirdIssues/Management/BCC.html to fully evaluate the effects to the birds at your site. This list identifies birds that are potentially threatened by disturbance and construction.

BALD AND GOLDEN EAGLES

The bald eagle (*Haliaeetus leucocephalus*) was delisted under the ESA on August 9, 2007. Both the bald eagle and golden eagle (*Aquila chrysaetos*) are still protected under the MBTA and BGEPA. The BGEPA affords both eagles protection in addition to that provided by the MBTA, in particular, by making it unlawful to "disturb" eagles. Under the BGEPA, the Service may issue limited permits to incidentally "take" eagles (e.g., injury, interfering with normal breeding, feeding, or sheltering behavior nest abandonment). For information on bald and golden eagle management guidelines, we recommend you review information provided at www.fws.gov/midwest/eagle/guidelines/bgepa.html.

On our web site www.fws.gov/southwest/es/NewMexico/SBC_intro.cfm, we have included conservation measures that can minimize impacts to federally listed and other sensitive species. These include measures for communication towers, power line safety for raptors, road and highway improvements, spring developments and livestock watering facilities, wastewater facilities, and trenching operations.

We also suggest you contact the New Mexico Department of Game and Fish, and the New Mexico Energy, Minerals, and Natural Resources Department, Forestry Division for information regarding State fish, wildlife, and plants.

Thank you for your concern for endangered and threatened species and New Mexico’s wildlife habitats. We appreciate your efforts to identify and avoid impacts to listed and sensitive species in your project area. For further consultation on your proposed activity, please call 505-346-2525 or email nmesfo@fws.gov and reference your Service Consultation Tracking Number.

Attachment

United States Department of Interior
Fish and Wildlife Service

Project name: Four Corners Navajo Mine Energy Project

Official Species List

Provided by:

New Mexico Ecological Services Field Office

2105 OSUNA ROAD NE

ALBUQUERQUE, NM 87113

(505) 346-2525

http://www.fws.gov/southwest/es/NewMexico/

Non-participating U.S. Fish and Wildlife Service office(s):

The following office(s) have jurisdictions that overlap your project area, but do not provide automatically generated Species list documents. Please contact them directly to request a Species list document. Do this by visiting their website, if it is provided below. If a website is not provided, contact the office(s) by mail or phone.

Arizona Ecological Services Field Office

2321 WEST ROYAL PALM ROAD, SUITE 103

PHOENIX, AZ 85021

(602) 242-0210

http://www.fws.gov/southwest/es/arizona/

http://www.fws.gov/southwest/es/EndangeredSpecies/lists/

Consultation Tracking Number: 02ENNM00-2014-SLI-0064

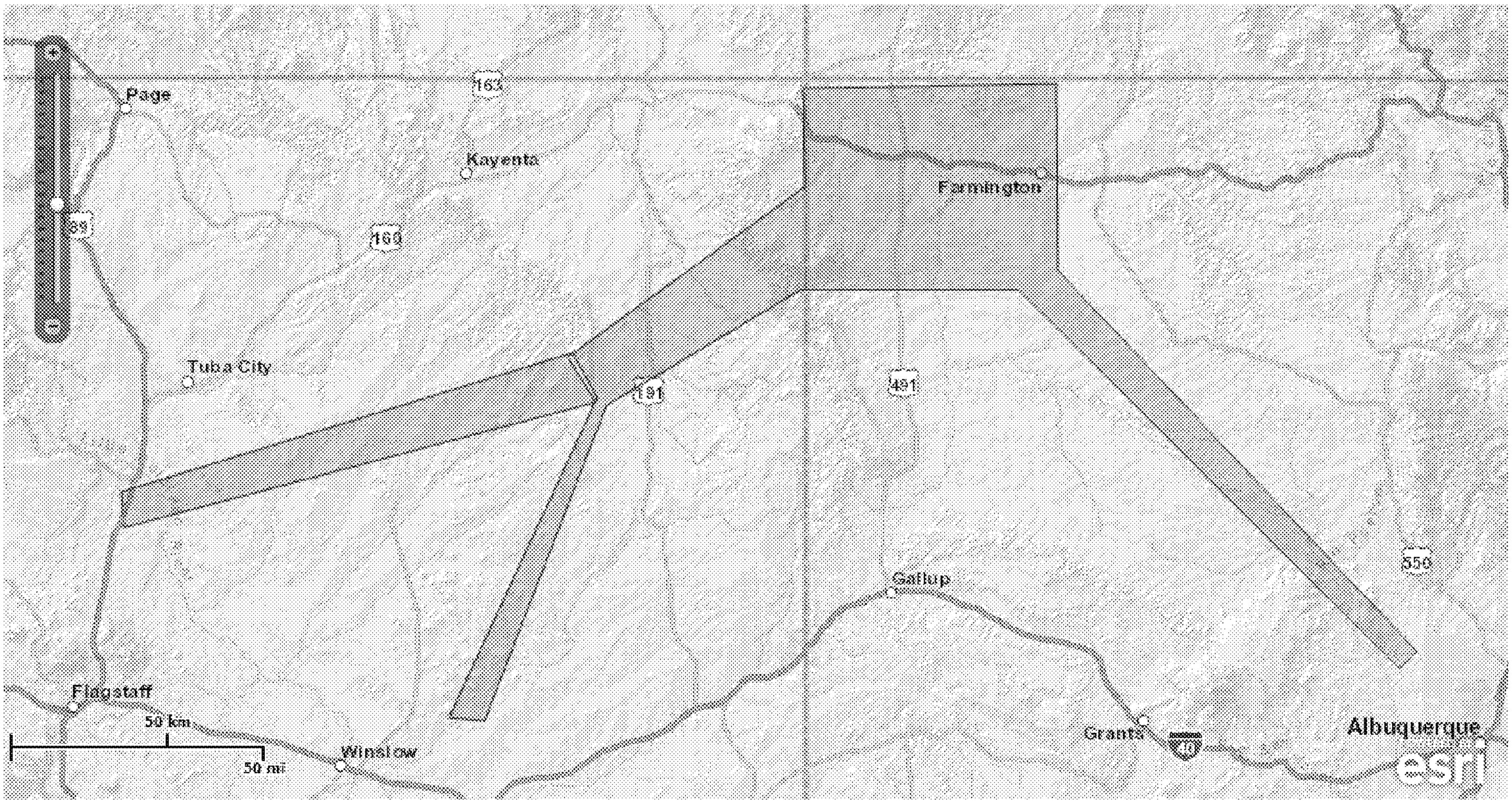
Project Type: Power Generation

Project Description: Issuance of new mining permit for Navajo Mine in San Juan County, NM and ongoing operation of the FCPP. ROW renewals for associated transmission lines extending across San Juan, McKinley and Sandoval counties, NM and Apache, Navajo and Cococino counties, NM.

United States Department of Interior
Fish and Wildlife Service

Project name: Four Corners Navajo Mine Energy Project

Project Location Map:



Project Coordinates: MULTIPOLYGON (((-109.86776094 36.21214718, -109.8855582 36.2018869, -109.78781391 36.07383015, -109.78893766 36.07186055, -111.4620963 35.7116636, -111.4 35.8141834, -109.8690787 36.2140758, -109.86776094 36.21214718)), ((-109.78893766 36.07186055, -109.7866813 36.0723463, -109.78781391 36.07383015, -109.7811881 36.0854432, -109.86776094 36.21214718, -109.0451041 36.6864163, -109.0505973 36.9680426, -108.1497184 36.9814275, -108.1442252 36.4486172, -106.8698111 35.3540456, -106.9302359 35.3047485, -108.2870475 36.3955753, -109.0560904 36.3955753, -109.7482291 36.0632438, -110.1821891 35.152186, -110.3085318 35.1611682, -109.78893766 36.07186055)))

Project Counties: Apache, AZ | Coconino, AZ | Navajo, AZ | McKinley, NM | San Juan, NM | Sandoval, NM

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Endangered Species Act Species List

There are a total of 15 threatened, endangered, or candidate species on your species list. Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. Critical habitats listed on the **Has Critical Habitat** lines may or may not lie within your project area. See the **Critical habitats within your project area** section further below for critical habitat that lies within your project. Please contact the designated FWS office if you have questions.

Colorado pikeminnow *(Ptychocheilus lucius)*
Population: except Salt and Verde R. drainages, AZ
Listing Status: Endangered
Has Critical Habitat: Final designated

Jemez Mountains salamander *(Plethodon neomexicanus)*
Listing Status: Endangered

Knowlton's cactus *(Pediocactus knowltonii)*
Listing Status: Endangered

Mancos milk-vetch *(Astragalus humillimus)*
Listing Status: Endangered

Mesa Verde cactus *(Sclerocactus mesae-verdae)*
Listing Status: Threatened

Mexican Spotted owl *(Strix occidentalis lucida)*
Population: Entire
Listing Status: Threatened
Has Critical Habitat: Final designated

New Mexico meadow jumping mouse *(Zapus hudsonius luteus)*
Listing Status: Proposed Endangered

Razorback sucker *(Xyrauchen texanus)*

Population: Entire

Listing Status: Endangered

Has Critical Habitat: Final designated

Rio Grande Cutthroat trout *(Oncorhynchus clarkii virginalis)*

Listing Status: Candidate

Rio Grande Silvery minnow *(Hybognathus amarus)*

Population: Entire, except where listed as an experimental population

Listing Status: Endangered

Has Critical Habitat: Final designated

Southwestern Willow flycatcher *(Empidonax traillii extimus)*

Population: Entire

Listing Status: Endangered

Has Critical Habitat: Final designated

Sprague's Pipit *(Anthus spragueii)*

Listing Status: Candidate

Yellow-Billed Cuckoo *(Coccyzus americanus)*

Population: Western U.S. DPS

Listing Status: Proposed Threatened

Zuni Bluehead Sucker *(Catostomus discobolus yarrowi)*

Listing Status: Proposed Endangered

Zuni fleabane *(Erigeron rhizomatus)*

Listing Status: Threatened

Critical habitats that lie within your project area

The following critical habitats lie fully or partially within your project area.

Species	Critical Habitat Type
Colorado pikeminnow *(Ptychocheilus lucius)* Population: except Salt and Verde R. drainages, AZ	Final designated
Razorback sucker *(Xyrauchen texanus)* Population: Entire	Final designated

Apache County

COMMON NAME	SCIENTIFIC NAME	STATUS	DESCRIPTION	COUNTY	ELEVATION	HABITAT	COMMENTS
Apache (Arizona) trout	*Oncorhynchus gilae apache*	Threatened	Yellowish to yellow-olive cutthroat-like trout with large dark spots on body. Dorsal, anal, and caudal fins edged with white. No red lateral band.	Apache, Coconino, Gila, Greenlee	> 5,000 ft	Streams and rivers generally above 6,000 ft. elevation with adequate stream flow and shading; temperatures below 77 degrees F; and substrate composed of boulders, rocks, gravel and some sand and silt.	Presently restricted to drainages in the White Mountains. Hybridization with introduced trout has complicated efforts to maintain the genetic purity of some populations. Special regulations (4d Rule) allow Arizona to manage the species as a sport fish (40 FR 29863).
Black-footed ferret	*Mustela nigripes*	Endangered	Weasel-like, yellow buff coloration with black on feet, tail tip, and eye mask. It has a blunt light colored nose and is 15-18 inches long and tail length is 5-6 inches.	Apache, Coconino, Navajo, Yavapai	< 10,500 ft	Grassland plains generally found in association with prairie dogs.	Unsurveyed prairie dog towns may be occupied by ferrets or may be appropriate for future reintroduction efforts. The Service developed guidelines for surveying prairie dog towns which are available upon request. No wild populations of this species are currently known to exist in Arizona. Reintroduced population exists in Aubrey Valley (Coconino County), Arizona.
California condor	*Gymnogyps californianus*	Endangered	Very large vulture (47 in., wingspan to 9 1/2 ft, weight to 22 lbs); adult plumage blackish, immature more brownish; adult wing linings white, immature mottled; head and upper parts of neck bare; yellow-orange in adults, grayish in mature.	Apache, Coconino, Mohave, Navajo, Yavapai	Varies	High desert canyons and plateaus.	Recovery program has reintroduced condors to Northern Arizona, with the first release (6 birds) in December 1996. The release site is located at the Vermillion Cliffs (Coconino County), with an experimental, nonessential area designated for most of Northern Arizona and Southern Utah. The area in Arizona is within a polygon formed by Hwy 191, Interstate 40, and Hwy 93, and extends north of the Arizona-Utah and Nevada borders. Breeding is documented in Arizona.

COMMON NAME	SCIENTIFIC NAME	STATUS	DESCRIPTION	COUNTY	ELEVATION	HABITAT	COMMENTS
Chiricahua leopard frog	*Lithobates chiricahuensis*	Threatened	Cream colored tubercles (spots) on a dark background on the rear of the thigh, dorsolateral folds that are interrupted and deflected medially, and a call given out of water distinguish this spotted frog from other leopard frogs.	Apache, Cochise, Coconino, Gila, Graham, Greenlee, Navajo, Pima, Santa Cruz, Yavapai	3,281-8,890 ft	Restricted to springs, livestock tanks, and streams in upper portion of watersheds that are free from nonnative predators or where marginal habitat for nonnative predators exists.	Critical habitat is designated for 10,346 acres in Apache, Cochise, Gila, Graham, Greenlee, Pima, Santa Cruz, and Yavapai counties in Arizona; and Catron, Hidalgo, Grant, Sierra, and Socorro counties in New Mexico (77 FR 16324).
Little Colorado spinedace	*Lepidomeda vittata*	Threatened	Small (<4 inches long) silvery minnow.	Apache, Coconino, Navajo	4,000-8,000 ft	Moderate to small streams; found in pools and riffles with water flowing over fine gravel and silt substrate.	Critical habitat includes 18 miles of East Clear Creek, 8 miles of Chevelon Creek, and 5 miles of Nutrioso Creek (52 FR 35034).
Loach minnow	*Tiaroga cobitis*	Endangered	Small (<3 inches) slender, elongated fish, olive colored with dirty white spots at the base of the dorsal and caudal fins. Breeding males vivid red on mouth and base of fins.	Apache, Cochise, Gila, Graham, Greenlee, Navajo, Pinal, Yavapai	< 8,000 ft	Benthic species of small to large perennial streams with swift shallow water over cobble and gravel. Recurrent flooding and natural hydrograph important.	Presently found in Aravaipa Creek, Deer Creek, Turkey Creek, Blue River, Campbell Blue Creek, Little Blue Creek, San Francisco River, Eagle Creek, North Fork of the East Fork Black River, Boneyard Creek, and White River and East Fork White River in Arizona, and Dry Blue Creek, Pace Creek, Frieborn Creek, the San Francisco River, Tularosa River, Negrito Creek, Whitewater Creek, the East, Middle, and West Forks of the Gila River, mainstem upper Gila River. Bear Creek and Mangas Creek in New Mexico. Populations have been recently reintroduced in Hot Springs and Redfield canyons in Cochise and Graham counties; Fossil Creek in Gila County; and Bonita Creek in Graham County Arizona. Critical habitat has been designated in Apache, Cochise, Gila, Graham, Greenlee, Pinal, and Yavapai counties, Arizona, as well as in Catron, Grant, and Hidalgo counties in New Mexico (77 FR 10810).

COMMON NAME	SCIENTIFIC NAME	STATUS	DESCRIPTION	COUNTY	ELEVATION	HABITAT	COMMENTS
Mexican gray wolf	*Canis lupus baileyi*	Endangered	Large dog-like carnivore. Head and feet are large in proportion to rest of body. Coat color varies with mix of brown, rust, black, gray, and white. Distinct white lip line around mouth. Adults weigh between 60-90 pounds.	Apache, Gila, Greenlee, Navajo	4,000-12,000 ft	Chaparral, woodland, and forested areas. May cross desert areas.	In January 1998, Mexican gray wolves were reintroduced as an experimental nonessential section 10(j) population under a program to re-establish the subspecies to a portion of its historical range (63 FR 1752). Wolves are released within the experimental boundary into a designated area known as the "Blue Range Wolf Recovery Area" (BRWRA) located in the Apache National Forest in Apache and Greenlee counties. Mexican gray wolves found outside of the experimental nonessential boundary are considered endangered. In 2002, the White Mountain Apache tribe (WMAT) became one of the lead agencies for the reintroduction and allowed wolves on their lands. This effectively expanded the experimental nonessential population into Apache, Gila, and Navajo counties on WMAT lands.
Mexican spotted owl	*Strix occidentalis lucida*	Threatened	Medium sized with dark eyes and no ear tufts. Brownish and heavily spotted with white or beige.	Apache, Cochise, Coconino, Gila, Graham, Greenlee, Maricopa, Mohave, Navajo, Pima, Pinal, Santa Cruz, Yavapai	4,100-9,000 ft	Nests in canyons and dense forests with multi-layered foliage structure.	Generally nest in older forests of mixed conifer or ponderosa pine/gambel oak type, in canyons, and use variety of habitats for foraging. Sites with cool microclimates appear to be of importance or are preferred. Critical habitat was finalized on August 31, 2004 (69 FR 53182) in Arizona in Apache, Cochise, Coconino, Gila, Graham, Greenlee, Maricopa, Navajo, Pima, Pinal, Santa Cruz, and Yavapai counties.

COMMON NAME	SCIENTIFIC NAME	STATUS	DESCRIPTION	COUNTY	ELEVATION	HABITAT	COMMENTS
Narrow-headed Gartersnake	*Thamnophis rufipunctatus*	Proposed Threatened	A small to medium-sized gartersnake with a maximum total length of 44 in. The base color is usually tan or grey-brown with conspicuous brown, black, or reddish spots that become indistinct toward the tail. Its eyes are set high on elongated head, which narrows to the snout. Base color is usually tan or grey-brown (but may darken) with conspicuous brown, black, or reddish spots that become indistinct towards the tail. Scales are keeled.	Apache, Coconino, Gila, Graham, Greenlee, Navajo, Yavapai	2,300-8,200 ft	Clear, rocky streams using predominantly pool and riffle habitat that includes cobbles and boulders.	Lacks striping on the dorsum and sides, which distinguishes its appearance from other gartersnake species with which it could co-occur. Most likely surface active between March and November when air temperatures range from 52-89°F and water temperatures range from 54-72°F. Approximately 1,503 stream miles are being proposed for critical habitat (78 FR 41500).
Navajo sedge	*Carex specuicola*	Threatened	Perennial forb with triangular stems, elongated rhizomes. Flower: white June and July.	Apache, Coconino, Navajo	5,700-6,000 ft	Silty soils at shady seeps and springs.	Designated critical habitat is on the Navajo Nation near Inscription House Ruins. Found at seep springs on vertical cliffs of pink-red Navajo sandstone (50 FR 19370).
New Mexico meadow jumping mouse	*Zapus hudsonius luteus*	Proposed Endangered	Small rodent with extremely long tail and long hind feet. Pelage is coarse with a broad dorsal band of brown or yellowish brown darkened with brownish black hairs; sides paler; under parts white or sometimes suffused with yellowish color. Back of the forefeet and hind feet are grayish white; tail is sparsely haired and distinctly bicolor (dark brown above and yellowish white below). The head is small, narrow, and relatively high crowned. The nose is short and pointed. They are the only mammal with 18 teeth.	Apache, Greenlee	< 8,000 ft	Nests in dry soils but also uses moist, streamside, dense riparian/wetland vegetation.	Since 2005, the New Mexico meadow jumping mouse is diminished to 12 populations in the White Mountains, Arizona. Critical habitat is proposed in Apache and Greenlee counties, Arizona (78 FR 37328). Proposed critical habitat includes the riparian communities along rivers and streams, springs and wetlands, canals and ditches as well as the adjacent floodplain and upland areas extending approximately 100 m (300 ft) outward from the water's edge (as defined as bankfull stage of streams).

COMMON NAME	SCIENTIFIC NAME	STATUS	DESCRIPTION	COUNTY	ELEVATION	HABITAT	COMMENTS
Northern Mexican Gartersnake	*Thamnophis eques megalops*	Proposed Threatened	Background color ranges from olive, olive-brown, to olive-gray. Body has three yellow or light colored stripes running down the length of the body, darker towards tail. Species distinguished from other native gartersnakes by the lateral stripes reaching the 3rd and 4th scale rows. Paired black spots extend along dorsolateral fields.	Apache, Cochise, Coconino, Gila, Graham, Greenlee, La Paz, Mohave, Navajo, Pima, Pinal, Santa Cruz, Yavapai	130-8,497 ft	Cienegas, stock tanks, large-river riparian woodlands and forests, streamside gallery forests.	Core population areas in Arizona include mid/upper Verde River drainage, mid/lower Tonto Creek, and the San Rafael Valley and surrounding area. Status on tribal lands unknown. Occurs in Grant and Catron Counties in New Mexico. Distributed south into Mexico along the Sierra Madre Occidental and Mexican Plateau. Strongly associated with the presence of a native prey base including leopard frogs and native fish.
Southwestern willow flycatcher	*Empidonax traillii extimus*	Endangered	Small passerine (about 6 inches) grayish-green back and wings, whitish throat, light olive-gray breast and pale yellowish belly. Two wingbars visible. Eye-ring faint or absent.	Apache, Cochise, Coconino, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Navajo, Pima, Pinal, Santa Cruz, Yavapai, Yuma	< 8,500 ft	Cottonwood/willow and tamarisk vegetation communities along rivers and streams.	Riparian-obligate bird that migrates and nests from late April-Sept along river and streams. A revised critical habitat designation was finalized on January 3, 2013, for areas in Apache, Cochise, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Pima, Pinal, Santa Cruz, and Yavapai counties (78 FR 344). Training seminar/permits (state and federal) necessary for those conducting call playback surveys.
Three Forks springsnail	*Pyrgulopsis trivialis*	Endangered	Minute hydrobiid snail; shell ovate to narrowly conic; height 0.05 -0.17 inches; whorls 2.5-5.0	Apache	8,000-8,500 ft	Rheocrene springs, seeps, marshes, spring pools, outflows and diverse lotic waters.	Distribution limited to Boneyard Creek and Boneyard Bog Spring complexes in the North Fork of the East Fork Black River watershed. Critical habitat is designated for 17.2 acres (77 FR 23060).
Welsh's milkweed	*Asclepias welshii*	Threatened	Milkweed family (Asclepiadaceae), rhizomatous, herbaceous perennial, 10-40 inches tall with large oval leaves. Flowers: cream colored, rose tinged in center, and bloom in June and July. Juvenile form has long, linear leaves, so is easily overlooked or misidentified.	Apache, Coconino, Navajo	4700-6250 ft	Open, sparsely vegetated semi-stabilized sand dunes and on lee slopes of actively drifting sand dunes.	Small populations known from south of Monument Valley, north of Tuba City, west of Page and west of the Paria-Vermillion cliffs Wilderness Area on the Utah/Arizona border. Designated critical habitat is in Utah (52 FR 41435).

COMMON NAME	SCIENTIFIC NAME	STATUS	DESCRIPTION	COUNTY	ELEVATION	HABITAT	COMMENTS
Yellow-billed cuckoo	*Coccyzus americanus*	Proposed threatened	Medium-sized bird with a slender, long-tailed profile, slightly down-curved bill that is blue-black with yellow on the lower half. Plumage is grayish-brown above and white below, with rufous primary flight feathers.	Apache, Cochise, Coconino, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Navajo, Pima, Pinal, Santa Cruz, Yavapai, Yuma	< 6,500 ft	Large blocks of riparian woodlands (cottonwood, willow, or tamarisk galleries).	Neotropical migrant that winters primarily in South America and breeds primarily in the U.S. (but also in southern Canada and northern Mexico). As a migrant it is rarely detected; can occur outside of riparian areas. Cuckoos are found nesting statewide, mostly below 5,000 feet in central, western, and southeastern Arizona. Concern for cuckoos are primarily focused upon alterations to its nesting and foraging habitat. Nesting cuckoos are associated with relatively dense, wooded, streamside riparian habitat, with varying combinations of Fremont cottonwood, willow, velvet ash, Arizona walnut, mesquite, and tamarisk. Some cuckoos have also been detected nesting in velvet mesquite, netleaf hackberry, Arizona sycamore, Arizona alder, and some exotic neighborhood shade trees.
Zuni bluehead sucker	*Catostomus discorbolus yarrowi*	Proposed Endangered	Fusiform, slender, with a terminal mouth. Bluish head, silvery tan to dark green above, silvery to yellowish or dirty-white below. Sexually mature bluehead suckers range between 3.5 to 8 inches in length.	Apache	> 6,000 ft	Small streams in low-velocity, moderate deep pools, and pool-runs with seasonal dense algae. Young prefer quieter shallow areas near shoreline.	Found in two drainages on the Navajo Nation (Kinlichee Creek [Little Colorado River] and Canyon de Chelly [San Juan River]) in Arizona and in the Zuni River in New Mexico on lands of the Zuni Pueblo, Forest Service, State of New Mexico, and private lands. Critical habitat is proposed for 475.3 km (291.3 mi) of streams in Apache County, Arizona and Cibola, McKinley, and San Juan counties, New Mexico. Conservation actions for the subspecies are included in the Zuni Bluehead Sucker Recovery Plan (New Mexico Department of Game and Fish) and the Arizona Statewide Conservation Program for Six Native Fish (Arizona Game and Fish Department).
Zuni fleabane	*Erigeron rhizomatus*	Threatened	Herbaceous perennial that grows in clusters of numerous erect unbranced stems up to 2.0 feet tall. Flower heads solitary; pale blue ray flowers and yellow disk flowers.	Apache	7,300-8,000 ft	Selenium-rich red or gray detrital clay soils derived from the Chinle and Baca formations.	Only one Arizona location; other 28 sites in Sawtooth Mountains and northwestern part of the Datil Mountains in Catron County, New Mexico. Two sites also on the northwest side of the Zuni Mountains in McKinley County, New Mexico.

COMMON NAME	SCIENTIFIC NAME	STATUS	DESCRIPTION	COUNTY	ELEVATION	HABITAT	COMMENTS
Roundtail chub	*Gila robusta*	Candidate	Member of the minnow family Cyprinidae and characterized by streamlined body shape. Color usually olive gray with silvery sides and a white belly. Breeding males develop red or orange coloration on the lower half of the cheeks and on the bases of paired fins. Individuals may reach 49.0 cm (19.3 in) but usually average 25-30 cm (9.8 - 11.8 in).	Apache, Coconino, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Navajo, Pinal, Yavapai	1,000-7,500 ft.	Cool to warm waters of rivers and streams, often occupy the deepest pools and eddies of large streams.	Historical range of roundtail chub included both the upper and lower Colorado River basins. A 2009 status review determined that the lower Colorado River basin roundtail chub population segment (Arizona and New Mexico) qualifies as a distinct vertebrate population segment (DPS). Populations in the Little Colorado, Bill Williams, and Gila River basins are considered candidate species.
Arizona willow	*Salix arizonica*	Conservation Agreement	Woody, perennial shrub reaching up to 8.5 feet tall; grows as a prostrate mat to large hedge or thicket plant; has small, egg-shaped leaves; new branches are yellow-green, previous years branches are bright red.	Apache	> 8,000 ft	Unshaded or partially shaded wet meadows, streamsides and cienegas; typically found in or adjacent to perennial water.	Known in the vicinity of Mount Baldy, on the Apache-Sitgreaves National Forest, and private land. Conservation agreement between the Service, Forest Service, and National Park Service finalized in April 1995.
Gooddings onion	*Allium gooddingii*	Conservation Agreement	Herbaceous perennial plant; broad, flat, rather blunt leaves; flowering stalk 14-18 inches tall, flattened, and narrowly winged toward apex; fruit is broader than long; seeds are short and thick.	Apache, Greenlee, Pima	7,500-11,250 ft	Shaded sites on north-trending drainages, on slopes, or in narrow canyons, within mixed conifer and spruce fir forests.	Known from the White, Santa Catalina, and Chuska Mountains. Also found in New Mexico on the Lincoln and Gila National Forests. A Conservation Agreement between the Service and the Forest Service signed in February 1998.
American peregrine falcon	*Falco pereginus anatum*	Delisted	A crow-sized falcon with slate blue-gray on the back and wings, and white on the underside; a black head with vertical "bandit's mask" pattern over the eyes; long pointed wings; and a long wailing call made during breeding. Very adept flyers and hunters, reaching diving speeds of 200 mph.	Apache, Cochise, Coconino, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Navajo, Pima, Pinal, Santa Cruz, Yavapai, Yuma	3,500-9,000 ft	Areas with rocky, steep cliffs, primarily near water, where prey (primarily shorebirds, songbirds, and waterfowl) concentrations are high. Nests are found on ledges of cliffs, and sometimes on man-made structures such as office towers and bridge abutments.	Species recovered with over 1,650 breeding birds in the US and Canada.

COMMON NAME	SCIENTIFIC NAME	STATUS	DESCRIPTION	COUNTY	ELEVATION	HABITAT	COMMENTS
Bald eagle	*Haliaeetus leucocephalus*	Delisted	Large, adults have white head and tail. Height 28 to 38 inches; wingspan 66 to 96 inches. Juveniles and subadults are dark brown with varying degrees of white mottling on chest, wings, and head.	Apache, Coconino, Gila, Graham, La Paz, Maricopa, Mohave, Pinal, and Yavapai	Varies	Large trees or cliffs near water (reservoirs, rivers, and streams) with abundant prey.	Nationwide and throughout the State of Arizona, the bald eagle is currently not listed under the Endangered Species Act. On September 30, 2010, the U.S. District Court dissolved an injunction that led to the bald eagle in the Sonoran Desert Area of central Arizona being placed on the Endangered Species list in 2008. This determination is presently (January 2011) under judicial consideration. Bald eagles are protected under the Bald and Golden Eagle Protection Act (Eagle Act) and other Federal and state statutes. The word "disturb" under the Eagle Act was recently clarified, as well as the implementation of new regulations requiring permits to incidentally "take" eagles. Retrieve more information on management and life history at http://SWBEMC.org.

Navajo County

COMMON NAME	SCIENTIFIC NAME	STATUS	DESCRIPTION	COUNTY	ELEVATION	HABITAT	COMMENTS
Black-footed ferret	*Mustela nigripes*	Endangered	Weasel-like, yellow buff coloration with black on feet, tail tip, and eye mask. It has a blunt light colored nose and is 15-18 inches long and tail length is 5-6 inches.	Apache, Coconino, Navajo, Yavapai	< 10,500 ft	Grassland plains generally found in association with prairie dogs.	Unsurveyed prairie dog towns may be occupied by ferrets or may be appropriate for future reintroduction efforts. The Service developed guidelines for surveying prairie dog towns which are available upon request. No wild populations of this species are currently known to exist in Arizona. Reintroduced population exists in Aubrey Valley (Coconino County), Arizona.
California condor	*Gymnogyps californianus*	Endangered	Very large vulture (47 in., wingspan to 9 1/2 ft, weight to 22 lbs); adult plumage blackish, immature more brownish; adult wing linings white, immature mottled; head and upper parts of neck bare; yellow-orange in adults, grayish in mature.	Apache, Coconino, Mohave, Navajo, Yavapai	Varies	High desert canyons and plateaus.	Recovery program has reintroduced condors to Northern Arizona, with the first release (6 birds) in December 1996. The release site is located at the Vermillion Cliffs (Coconino County), with an experimental, nonessential area designated for most of Northern Arizona and Southern Utah. The area in Arizona is within a polygon formed by Hwy 191, Interstate 40, and Hwy 93, and extends north of the Arizona-Utah and Nevada borders. Breeding is documented in Arizona.
Chiricahua leopard frog	*Lithobates chiricahuensis*	Threatened	Cream colored tubercles (spots) on a dark background on the rear of the thigh, dorsolateral folds that are interrupted and deflected medially, and a call given out of water distinguish this spotted frog from other leopard frogs.	Apache, Cochise, Coconino, Gila, Graham, Greenlee, Navajo, Pima, Santa Cruz, Yavapai	3,281-8,890 ft	Restricted to springs, livestock tanks, and streams in upper portion of watersheds that are free from nonnative predators or where marginal habitat for nonnative predators exists.	Critical habitat is designated for 10,346 acres in Apache, Cochise, Gila, Graham, Greenlee, Pima, Santa Cruz, and Yavapai counties in Arizona; and Catron, Hidalgo, Grant, Sierra, and Socorro counties in New Mexico (77 FR 16324).
Little Colorado spinedace	*Lepidomeda vittata*	Threatened	Small (<4 inches long) silvery minnow.	Apache, Coconino, Navajo	4,000-8,000 ft	Moderate to small streams; found in pools and riffles with water flowing over fine gravel and silt substrate.	Critical habitat includes 18 miles of East Clear Creek, 8 miles of Chevelon Creek, and 5 miles of Nutrioso Creek (52 FR 35034).

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COMMON NAME	SCIENTIFIC NAME	STATUS	DESCRIPTION	COUNTY	ELEVATION	HABITAT	COMMENTS
Loach minnow	*Tiaroga cobitis*	Endangered	Small (<3 inches) slender, elongated fish, olive colored with dirty white spots at the base of the dorsal and caudal fins. Breeding males vivid red on mouth and base of fins.	Apache, Cochise, Gila, Graham, Greenlee, Navajo, Pinal, Yavapai	< 8,000 ft	Benthic species of small to large perennial streams with swift shallow water over cobble and gravel. Recurrent flooding and natural hydrograph important.	Presently found in Aravaipa Creek, Deer Creek, Turkey Creek, Blue River, Campbell Blue Creek, Little Blue Creek, San Francisco River, Eagle Creek, North Fork of the East Fork Black River, Boneyard Creek, and White River and East Fork White River in Arizona, and Dry Blue Creek, Pace Creek, Frieborn Creek, the San Francisco River, Tularosa River, Negrito Creek, Whitewater Creek, the East, Middle, and West Forks of the Gila River, mainstem upper Gila River. Bear Creek and Mangas Creek in New Mexico. Populations have been recently reintroduced in Hot Springs and Redfield canyons in Cochise and Graham counties; Fossil Creek in Gila County; and Bonita Creek in Graham County Arizona. Critical habitat has been designated in Apache, Cochise, Gila, Graham, Greenlee, Pinal, and Yavapai counties, Arizona, as well as in Catron, Grant, and Hidalgo counties in New Mexico (77 FR 10810).
Mexican gray wolf	*Canis lupus baileyi*	Endangered	Large dog-like carnivore. Head and feet are large in proportion to rest of body. Coat color varies with mix of brown, rust, black, gray, and white. Distinct white lip line around mouth. Adults weigh between 60-90 pounds.	Apache, Gila, Greenlee, Navajo	4,000-12,000 ft	Chaparral, woodland, and forested areas. May cross desert areas.	In January 1998, Mexican gray wolves were reintroduced as an experimental nonessential section 10(j) population under a program to re-establish the subspecies to a portion of its historical range (63 FR 1752). Wolves are released within the experimental boundary into a designated area known as the "Blue Range Wolf Recovery Area" (BRWRA) located in the Apache National Forest in Apache and Greenlee counties. Mexican gray wolves found outside of the experimental nonessential boundary are considered endangered. In 2002, the White Mountain Apache tribe (WMAT) became one of the lead agencies for the reintroduction and allowed wolves on their lands. This effectively expanded the experimental nonessential population into Apache, Gila, and Navajo counties on WMAT lands.

COMMON NAME	SCIENTIFIC NAME	STATUS	DESCRIPTION	COUNTY	ELEVATION	HABITAT	COMMENTS
Mexican spotted owl	*Strix occidentalis lucida*	Threatened	Medium sized with dark eyes and no ear tufts. Brownish and heavily spotted with white or beige.	Apache, Cochise, Coconino, Gila, Graham, Greenlee, Maricopa, Mohave, Navajo, Pima, Pinal, Santa Cruz, Yavapai	4,100-9,000 ft	Nests in canyons and dense forests with multi-layered foliage structure.	Generally nest in older forests of mixed conifer or ponderosa pine/gambel oak type, in canyons, and use variety of habitats for foraging. Sites with cool microclimates appear to be of importance or are preferred. Critical habitat was finalized on August 31, 2004 (69 FR 53182) in Arizona in Apache, Cochise, Coconino, Gila, Graham, Greenlee, Maricopa, Navajo, Pima, Pinal, Santa Cruz, and Yavapai counties.
Narrow-headed Gartersnake	*Thamnophis rufipunctatus*	Proposed Threatened	A small to medium-sized gartersnake with a maximum total length of 44 in. The base color is usually tan or grey-brown with conspicuous brown, black, or reddish spots that become indistinct toward the tail. Its eyes are set high on elongated head, which narrows to the snout. Base color is usually tan or grey-brown (but may darken) with conspicuous brown, black, or reddish spots that become indistinct towards the tail. Scales are keeled.	Apache, Coconino, Gila, Graham, Greenlee, Navajo, Yavapai	2,300-8,200 ft	Clear, rocky streams using predominantly pool and riffle habitat that includes cobbles and boulders.	Lacks striping on the dorsum and sides, which distinguishes its appearance from other gartersnake species with which it could co-occur. Most likely surface active between March and November when air temperatures range from 52-89°F and water temperatures range from 54-72°F. Approximately 1,503 stream miles are being proposed for critical habitat (78 FR 41500).
Navajo sedge	*Carex specuicola*	Threatened	Perennial forb with triangular stems, elongated rhizomes. Flower: white June and July.	Apache, Coconino, Navajo	5,700-6,000 ft	Silty soils at shady seeps and springs.	Designated critical habitat is on the Navajo Nation near Inscription House Ruins. Found at seep springs on vertical cliffs of pink-red Navajo sandstone (50 FR 19370).
Northern Mexican Gartersnake	*Thamnophis eques megalops*	Proposed Threatened	Background color ranges from olive, olive-brown, to olive-gray. Body has three yellow or light colored stripes running down the length of the body, darker towards tail. Species distinguished from other native gartersnakes by the lateral stripes reaching the 3rd and 4th scale rows. Paired black spots extend along dorsolateral fields.	Apache, Cochise, Coconino, Gila, Graham, Greenlee, La Paz, Mohave, Navajo, Pima, Pinal, Santa Cruz, Yavapai	130-8,497 ft	Cienegas, stock tanks, large-river riparian woodlands and forests, streamside gallery forests.	Core population areas in Arizona include mid/upper Verde River drainage, mid/lower Tonto Creek, and the San Rafael Valley and surrounding area. Status on tribal lands unknown. Occurs in Grant and Catron Counties in New Mexico. Distributed south into Mexico along the Sierra Madre Occidental and Mexican Plateau. Strongly associated with the presence of a native prey base including leopard frogs and native fish.

COMMON NAME	SCIENTIFIC NAME	STATUS	DESCRIPTION	COUNTY	ELEVATION	HABITAT	COMMENTS
Peebles Navajo cactus	*Pediocactus peeblesianus var. peeblesianus*	Endangered	Very small globose 1 inch tall and about 0.75 inch in diameter. The 4 (3-5) radial spines are arranged in a twisted cross and central spines are absent. Flowers yellow-green 1 inch diameter spring.	Navajo	5,400-5,600 ft	Gravely soils of the Shinarump conglomerate of the Chinle Formation.	Extremely limited geographic range. Difficult to grow in cultivation.
Southwestern willow flycatcher	*Empidonax traillii extimus*	Endangered	Small passerine (about 6 inches) grayish-green back and wings, whitish throat, light olive-gray breast and pale yellowish belly. Two wingbars visible. Eye-ring faint or absent.	Apache, Cochise, Coconino, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Navajo, Pima, Pinal, Santa Cruz, Yavapai, Yuma	< 8,500 ft	Cottonwood/willow and tamarisk vegetation communities along rivers and streams.	Riparian-obligate bird that migrates and nests from late April-Sept along river and streams. A revised critical habitat designation was finalized on January 3, 2013, for areas in Apache, Cochise, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Pima, Pinal, Santa Cruz, and Yavapai counties (78 FR 344). Training seminar/permits (state and federal) necessary for those conducting call playback surveys.
Welsh's milkweed	*Asclepias welshii*	Threatened	Milkweed family (Asclepiadaceae), rhizomatous, herbaceous perennial, 10-40 inches tall with large oval leaves. Flowers: cream colored, rose tinged in center, and bloom in June and July. Juvenile form has long, linear leaves, so is easily overlooked or misidentified.	Apache, Coconino, Navajo	4700-6250 ft	Open, sparsely vegetated semi-stabilized sand dunes and on lee slopes of actively drifting sand dunes.	Small populations known from south of Monument Valley, north of Tuba City, west of Page and west of the Paria-Vermillion cliffs Wilderness Area on the Utah/Arizona border. Designated critical habitat is in Utah (52 FR 41435).

COMMON NAME	SCIENTIFIC NAME	STATUS	DESCRIPTION	COUNTY	ELEVATION	HABITAT	COMMENTS
Yellow-billed cuckoo	*Coccyzus americanus*	Proposed threatened	Medium-sized bird with a slender, long-tailed profile, slightly down-curved bill that is blue-black with yellow on the lower half. Plumage is grayish-brown above and white below, with rufous primary flight feathers.	Apache, Cochise, Coconino, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Navajo, Pima, Pinal, Santa Cruz, Yavapai, Yuma	< 6,500 ft	Large blocks of riparian woodlands (cottonwood, willow, or tamarisk galleries).	Neotropical migrant that winters primarily in South America and breeds primarily in the U.S. (but also in southern Canada and northern Mexico). As a migrant it is rarely detected; can occur outside of riparian areas. Cuckoos are found nesting statewide, mostly below 5,000 feet in central, western, and southeastern Arizona. Concern for cuckoos are primarily focused upon alterations to its nesting and foraging habitat. Nesting cuckoos are associated with relatively dense, wooded, streamside riparian habitat, with varying combinations of Fremont cottonwood, willow, velvet ash, Arizona walnut, mesquite, and tamarisk. Some cuckoos have also been detected nesting in velvet mesquite, netleaf hackberry, Arizona sycamore, Arizona alder, and some exotic neighborhood shade trees.
Roundtail chub	*Gila robusta*	Candidate	Member of the minnow family Cyprinidae and characterized by streamlined body shape. Color usually olive gray with silvery sides and a white belly. Breeding males develop red or orange coloration on the lower half of the cheeks and on the bases of paired fins. Individuals may reach 49.0 cm (19.3 in) but usually average 25-30 cm (9.8 - 11.8 in).	Apache, Coconino, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Navajo, Pinal, Yavapai	1,000-7,500 ft.	Cool to warm waters of rivers and streams, often occupy the deepest pools and eddies of large streams.	Historical range of roundtail chub included both the upper and lower Colorado River basins. A 2009 status review determined that the lower Colorado River basin roundtail chub population segment (Arizona and New Mexico) qualifies as a distinct vertebrate population segment (DPS). Populations in the Little Colorado, Bill Williams, and Gila River basins are considered candidate species.

COMMON NAME	SCIENTIFIC NAME	STATUS	DESCRIPTION	COUNTY	ELEVATION	HABITAT	COMMENTS
American peregrine falcon	*Falco pereginus anatum*	Delisted	A crow-sized falcon with slate blue-gray on the back and wings, and white on the underside; a black head with vertical "bandit's mask" pattern over the eyes; long pointed wings; and a long wailing call made during breeding. Very adept flyers and hunters, reaching diving speeds of 200 mph.	Apache, Cochise, Coconino, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Navajo, Pima, Pinal, Santa Cruz, Yavapai, Yuma	3,500-9,000 ft	Areas with rocky, steep cliffs, primarily near water, where prey (primarily shorebirds, songbirds, and waterfowl) concentrations are high. Nests are found on ledges of cliffs, and sometimes on man-made structures such as office towers and bridge abutments.	Species recovered with over 1,650 breeding birds in the US and Canada.

Coconino County

COMMON NAME	SCIENTIFIC NAME	STATUS	DESCRIPTION	COUNTY	ELEVATION	HABITAT	COMMENTS
Apache (Arizona) trout	*Oncorhynchus gilae apache*	Threatened	Yellowish to yellow-olive cutthroat-like trout with large dark spots on body. Dorsal, anal, and caudal fins edged with white. No red lateral band.	Apache, Coconino, Gila, Greenlee	> 5,000 ft	Streams and rivers generally above 6,000 ft. elevation with adequate stream flow and shading; temperatures below 77 degrees F; and substrate composed of boulders, rocks, gravel and some sand and silt.	Presently restricted to drainages in the White Mountains. Hybridization with introduced trout has complicated efforts to maintain the genetic purity of some populations. Special regulations (4d Rule) allow Arizona to manage the species as a sport fish (40 FR 29863).
Black-footed ferret	*Mustela nigripes*	Endangered	Weasel-like, yellow buff coloration with black on feet, tail tip, and eye mask. It has a blunt light colored nose and is 15-18 inches long and tail length is 5-6 inches.	Apache, Coconino, Navajo, Yavapai	< 10,500 ft	Grassland plains generally found in association with prairie dogs.	Unsurveyed prairie dog towns may be occupied by ferrets or may be appropriate for future reintroduction efforts. The Service developed guidelines for surveying prairie dog towns which are available upon request. No wild populations of this species are currently known to exist in Arizona. Reintroduced population exists in Aubrey Valley (Coconino County), Arizona.
Brady pincushion cactus	*Pediocactus bradyi*	Endangered	Small, semi-globose cactus, 2.4 inches tall and 2 inches in diameter. Spines are white or yellowish-tan. The spine clusters 1-2 central spines and 14-15 spreading radial spines. Flower: straw yellow produced at top of the stem.	Coconino	3,850-4,500 ft	Benches and terraces in Navajo desert near Marble Gorge.	Substrate is Kaibab limestone chips over Moenkopi shale and sandstone soil. Plant community dominated by shadescale (Atriplex confertifolia), snakeweed (Gutierrezia sarothrae), mormon tea (Ephedra viridis), and desert trumpet (Eriogonum inflatum). Protected by CITES and Arizona Native Plant Law.

COMMON NAME	SCIENTIFIC NAME	STATUS	DESCRIPTION	COUNTY	ELEVATION	HABITAT	COMMENTS
California condor	*Gymnogyps californianus*	Endangered	Very large vulture (47 in., wingspan to 9 1/2 ft, weight to 22 lbs); adult plumage blackish, immature more brownish; adult wing linings white, immature mottled; head and upper parts of neck bare; yellow-orange in adults, grayish in mature.	Apache, Coconino, Mohave, Navajo, Yavapai	Varies	High desert canyons and plateaus.	Recovery program has reintroduced condors to Northern Arizona, with the first release (6 birds) in December 1996. The release site is located at the Vermillion Cliffs (Coconino County), with an experimental, nonessential area designated for most of Northern Arizona and Southern Utah. The area in Arizona is within a polygon formed by Hwy 191, Interstate 40, and Hwy 93, and extends north of the Arizona-Utah and Nevada borders. Breeding is documented in Arizona.
Chiricahua leopard frog	*Lithobates chiricahuensis*	Threatened	Cream colored tubercles (spots) on a dark background on the rear of the thigh, dorsolateral folds that are interrupted and deflected medially, and a call given out of water distinguish this spotted frog from other leopard frogs.	Apache, Cochise, Coconino, Gila, Graham, Greenlee, Navajo, Pima, Santa Cruz, Yavapai	3,281-8,890 ft	Restricted to springs, livestock tanks, and streams in upper portion of watersheds that are free from nonnative predators or where marginal habitat for nonnative predators exists.	Critical habitat is designated for 10,346 acres in Apache, Cochise, Gila, Graham, Greenlee, Pima, Santa Cruz, and Yavapai counties in Arizona; and Catron, Hidalgo, Grant, Sierra, and Socorro counties in New Mexico (77 FR 16324).
Fickeisen plains cactus	*Pediocactus peeblesianus var. fickeiseniae*	Endangered	Very small (3 in tall and 1.5 in diameter), unbranched cactus that retracts into gravely soils after flowering and fruiting. Tubercles form a spiral pattern around plant. Central spine 3/8 in long, flowers are cream/yellow.	Coconino, Mohave	4,200-5,950 ft	Well-drained, shallow, gravelly soils derived from exposed layers of Kaibab limestone.	Endemic to Colorado Plateau. Small populations found on mesas, plateaus, terraces, gently sloping hills, and near canyon rims. Critical habitat is being proposed for a total of 47,123 ac in Coconino and Mohave counties (78 FR 40673).
Humpback chub	*Gila cypha*	Endangered	Large (18 inches) minnow with flattened head, long fleshy snout, large fins, and a very large hump between the head and the dorsal fin.	Coconino, Mohave	< 4,000 ft	Large, warm turbid rivers especially canyon areas with deep fast water.	Species found in the Upper Colorado River basin in Utah and Colorado, and in the Little Colorado and Colorado Rivers in Marble and Grand Canyons, Arizona. Critical habitat designated in Arizona, Colorado, and Utah (59 FR 13374).

COMMON NAME	SCIENTIFIC NAME	STATUS	DESCRIPTION	COUNTY	ELEVATION	HABITAT	COMMENTS
Kanab ambersnail	*Oxyloma haydeni kanabensis*	Endangered	Small <0.7 inch, light amber color, sometimes grayish-amber mottled; right handed shell.	Coconino	2,900 ft	Travertine seeps and springs in Grand Canyon National Park.	Extremely geographically isolated. Three historical populations; two remaining; one on private property in Utah and one in Grand Canyon National Park; species affected by operations by Glen Canyon Dam. Associated with watercress, monkey flower, and other wetland vegetation.
Little Colorado spinedace	*Lepidomeda vittata*	Threatened	Small (<4 inches long) silvery minnow.	Apache, Coconino, Navajo	4,000-8,000 ft	Moderate to small streams; found in pools and riffles with water flowing over fine gravel and silt substrate.	Critical habitat includes 18 miles of East Clear Creek, 8 miles of Chevelon Creek, and 5 miles of Nutrioso Creek (52 FR 35034).
Mexican spotted owl	*Strix occidentalis lucida*	Threatened	Medium sized with dark eyes and no ear tufts. Brownish and heavily spotted with white or beige.	Apache, Cochise, Coconino, Gila, Graham, Greenlee, Maricopa, Mohave, Navajo, Pima, Pinal, Santa Cruz, Yavapai	4,100-9,000 ft	Nests in canyons and dense forests with multi-layered foliage structure.	Generally nest in older forests of mixed conifer or ponderosa pine/gambel oak type, in canyons, and use variety of habitats for foraging. Sites with cool microclimates appear to be of importance or are preferred. Critical habitat was finalized on August 31, 2004 (69 FR 53182) in Arizona in Apache, Cochise, Coconino, Gila, Graham, Greenlee, Maricopa, Navajo, Pima, Pinal, Santa Cruz, and Yavapai counties.
Narrow-headed Gartersnake	*Thamnophis rufipunctatus*	Proposed Threatened	A small to medium-sized gartersnake with a maximum total length of 44 in. The base color is usually tan or grey-brown with conspicuous brown, black, or reddish spots that become indistinct toward the tail. Its eyes are set high on elongated head, which narrows to the snout. Base color is usually tan or grey-brown (but may darken) with conspicuous brown, black, or reddish spots that become indistinct towards the tail. Scales are keeled.	Apache, Coconino, Gila, Graham, Greenlee, Navajo, Yavapai	2,300-8,200 ft	Clear, rocky streams using predominantly pool and riffle habitat that includes cobbles and boulders.	Lacks striping on the dorsum and sides, which distinguishes its appearance from other gartersnake species with which it could co-occur. Most likely surface active between March and November when air temperatures range from 52-89℉ and water temperatures range from 54-72℉. Approximately 1,503 stream miles are being proposed for critical habitat (78 FR 41500).

COMMON NAME	SCIENTIFIC NAME	STATUS	DESCRIPTION	COUNTY	ELEVATION	HABITAT	COMMENTS
Navajo sedge	*Carex specuicola*	Threatened	Perennial forb with triangular stems, elongated rhizomes. Flower: white June and July.	Apache, Coconino, Navajo	5,700-6,000 ft	Silty soils at shady seeps and springs.	Designated critical habitat is on the Navajo Nation near Inscription House Ruins. Found at seep springs on vertical cliffs of pink-red Navajo sandstone (50 FR 19370).
Northern Mexican Gartersnake	*Thamnophis eques megalops*	Proposed Threatened	Background color ranges from olive, olive-brown, to olive-gray. Body has three yellow or light colored stripes running down the length of the body, darker towards tail. Species distinguished from other native gartersnakes by the lateral stripes reaching the 3rd and 4th scale rows. Paired black spots extend along dorsolateral fields.	Apache, Cochise, Coconino, Gila, Graham, Greenlee, La Paz, Mohave, Navajo, Pima, Pinal, Santa Cruz, Yavapai	130-8,497 ft	Cienegas, stock tanks, large-river riparian woodlands and forests, streamside gallery forests.	Core population areas in Arizona include mid/upper Verde River drainage, mid/lower Tonto Creek, and the San Rafael Valley and surrounding area. Status on tribal lands unknown. Occurs in Grant and Catron Counties in New Mexico. Distributed south into Mexico along the Sierra Madre Occidental and Mexican Plateau. Strongly associated with the presence of a native prey base including leopard frogs and native fish.
Razorback sucker	*Xyrauchen texanus*	Endangered	Large, up to 3 feet long and up to 6 lbs, high sharp-edged keel-like hump behind the head. Head flattened on top. Olive-brown above to yellowish below.	Coconino, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Pinal, Yavapai, Yuma	< 6,000 ft	Riverine and lacustrine areas, generally not in fast moving water and may use backwaters.	Big River fish also found in Horseshoe reservoir (Maricopa County). Critical habitat includes the 100-year floodplain of the river through the Grand Canyon from confluence with Paria River to Hoover Dam; Hoover Dam to Davis Dam; Parker Dam to Imperial Dam. Also Gila River from Arizona/New Mexico border to Coolidge Dam; and Salt River from Hwy 60/SR77 Bridge to Roosevelt Dam; Verde River from FS boundary to Horseshoe Lake (59 FR 13374).
San Francisco Peaks groundsel	*Packera franciscana*	Threatened	Member of sunflower family, dwarf alpine species 1.2-4 inches tall. Leaves deeply lobed. Flowers: 0.5 inch diameter 1-6 yellow-gold flowers.	Coconino	> 10,900 ft	Alpine tundra	Found above spruce-fir and pine forests on talus slopes. Designated critical habitat is San Francisco Peaks (48 FR 52743).
Sentry milk vetch	*Astragalus cremnophylax var. cremnophylax*	Endangered	Usually less than 1 inch high and forms a mat 1-10 inches in diameter. Flowers: pale purple April to May.	Coconino	> 4,000 ft	Grows on a white layer of Kaibab limestone, with little or no soil, in an unshaded opening within a pinyon-juniper-cliffrose plant community.	Two known populations occur on the South Rim of Grand Canyon and a third recently discovered population on the North Rim.

COMMON NAME	SCIENTIFIC NAME	STATUS	DESCRIPTION	COUNTY	ELEVATION	HABITAT	COMMENTS
Siler pincushion cactus	*Pediocactus sileri*	Threatened	Small solitary or clustered cactus globose shaped about 5 inches tall and 3-4 inches in diameter. Flowers: yellow with maroon veins.	Coconino,Mohave	2,800-5,400 ft	Desertscrub transitional areas of Navajo, sagebrush and Mohave Deserts.	Grows on gypsiferous clay and sandy soils of Moenkopi formation.
Southwestern willow flycatcher	*Empidonax traillii extimus*	Endangered	Small passerine (about 6 inches) grayish-green back and wings, whitish throat, light olive-gray breast and pale yellowish belly. Two wingbars visible. Eye-ring faint or absent.	Apache, Cochise, Coconino, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Navajo, Pima, Pinal, Santa Cruz, Yavapai, Yuma	< 8,500 ft	Cottonwood/willow and tamarisk vegetation communities along rivers and streams.	Riparian-obligate bird that migrates and nests from late April-Sept along river and streams. A revised critical habitat designation was finalized on January 3, 2013, for areas in Apache, Cochise, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Pima, Pinal, Santa Cruz, and Yavapai counties (78 FR 344). Training seminar/permits (state and federal) necessary for those conducting call playback surveys.
Welsh's milkweed	*Asclepias welshii*	Threatened	Milkweed family (Asclepiadaceae), rhizomatous, herbaceous perennial, 10-40 inches tall with large oval leaves. Flowers: cream colored, rose tinged in center, and bloom in June and July. Juvenile form has long, linear leaves, so is easily overlooked or misidentified.	Apache, Coconino, Navajo	4700-6250 ft	Open, sparsely vegetated semi-stabilized sand dunes and on lee slopes of actively drifting sand dunes.	Small populations known from south of Monument Valley, north of Tuba City, west of Page and west of the Paria-Vermillion cliffs Wilderness Area on the Utah/Arizona border. Designated critical habitat is in Utah (52 FR 41435).

COMMON NAME	SCIENTIFIC NAME	STATUS	DESCRIPTION	COUNTY	ELEVATION	HABITAT	COMMENTS
Yellow-billed cuckoo	*Coccyzus americanus*	Proposed threatened	Medium-sized bird with a slender, long-tailed profile, slightly down-curved bill that is blue-black with yellow on the lower half. Plumage is grayish-brown above and white below, with rufous primary flight feathers.	Apache, Cochise, Coconino, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Navajo, Pima, Pinal, Santa Cruz, Yavapai, Yuma	< 6,500 ft	Large blocks of riparian woodlands (cottonwood, willow, or tamarisk galleries).	Neotropical migrant that winters primarily in South America and breeds primarily in the U.S. (but also in southern Canada and northern Mexico). As a migrant it is rarely detected; can occur outside of riparian areas. Cuckoos are found nesting statewide, mostly below 5,000 feet in central, western, and southeastern Arizona. Concern for cuckoos are primarily focused upon alterations to its nesting and foraging habitat. Nesting cuckoos are associated with relatively dense, wooded, streamside riparian habitat, with varying combinations of Fremont cottonwood, willow, velvet ash, Arizona walnut, mesquite, and tamarisk. Some cuckoos have also been detected nesting in velvet mesquite, netleaf hackberry, Arizona sycamore, Arizona alder, and some exotic neighborhood shade trees.
Roundtail chub	*Gila robusta*	Candidate	Member of the minnow family Cyprinidae and characterized by streamlined body shape. Color usually olive gray with silvery sides and a white belly. Breeding males develop red or orange coloration on the lower half of the cheeks and on the bases of paired fins. Individuals may reach 49.0 cm (19.3 in) but usually average 25-30 cm (9.8 - 11.8 in).	Apache, Coconino, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Navajo, Pinal, Yavapai	1,000-7,500 ft.	Cool to warm waters of rivers and streams, often occupy the deepest pools and eddies of large streams.	Historical range of roundtail chub included both the upper and lower Colorado River basins. A 2009 status review determined that the lower Colorado River basin roundtail chub population segment (Arizona and New Mexico) qualifies as a distinct vertebrate population segment (DPS). Populations in the Little Colorado, Bill Williams, and Gila River basins are considered candidate species.

COMMON NAME	SCIENTIFIC NAME	STATUS	DESCRIPTION	COUNTY	ELEVATION	HABITAT	COMMENTS
Arizona bugbane	*Cimicifuga arizonica*	Conservation Agreement	Herbaceous perennial plant in the buttercup family, grows 6-7 feet tall. Small, white petal-less flowers appear between July-August. Fruit is a follicle that splits open on one side as it dries.	Coconino, Gila	5,300-8,300 ft	Areas of deep shade and moist, loamy soils with high humus content, and high humidity; typically along the bottoms and lower slopes of steep narrow canyons.	Occurs within mixed conifer and high elevation riparian deciduous forests near perennial or intermittent streams or seeps. All known populations are found in the Coconino, Kaibab, and Tonto National Forests. A Conservation Agreement was signed in June 1999.
Paradine (Kaibab) plains cactus	*Pediocactus paradinei*	Conservation Agreement	Small, globose cactus (usually < 1.5 inches tall above ground and half of stem underground); can reach 2.5-3.0 inches in diameter; long, flexible, and hair like spines, 4-6 per aereole; flowers are cream to pale yellow with pink midrib.	Coconino	4,500-7,000 ft	May be restricted to Kaibab limestone soils in transitional areas between woodland and sagebrush communities.	Occurs exclusively on eastern slopes of Kaibab Plateau and on small portions of House Rock and Coyote valleys. A Conservation Agreement between the Service, Kaibab National Forest, and the Bureau of Land Management was signed on February 1998.
American peregrine falcon	*Falco pereginus anatum*	Delisted	A crow-sized falcon with slate blue-gray on the back and wings, and white on the underside; a black head with vertical “bandit’s mask” pattern over the eyes; long pointed wings; and a long wailing call made during breeding. Very adept flyers and hunters, reaching diving speeds of 200 mph.	Apache, Cochise, Coconino, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Navajo, Pima, Pinal, Santa Cruz, Yavapai, Yuma	3,500-9,000 ft	Areas with rocky, steep cliffs, primarily near water, where prey (primarily shorebirds, songbirds, and waterfowl) concentrations are high. Nests are found on ledges of cliffs, and sometimes on man-made structures such as office towers and bridge abutments.	Species recovered with over 1,650 breeding birds in the US and Canada.

COMMON NAME	SCIENTIFIC NAME	STATUS	DESCRIPTION	COUNTY	ELEVATION	HABITAT	COMMENTS
Bald eagle	*Haliaeetus leucocephalus*	Delisted	Large, adults have white head and tail. Height 28 to 38 inches; wingspan 66 to 96 inches. Juveniles and subadults are dark brown with varying degrees of white mottling on chest, wings, and head.	Apache, Coconino, Gila, Graham, La Paz, Maricopa, Mohave, Pinal, and Yavapai	Varies	Large trees or cliffs near water (reservoirs, rivers, and streams) with abundant prey.	Nationwide and throughout the State of Arizona, the bald eagle is currently not listed under the Endangered Species Act. On September 30, 2010, the U.S. District Court dissolved an injunction that led to the bald eagle in the Sonoran Desert Area of central Arizona being placed on the Endangered Species list in 2008. This determination is presently (January 2011) under judicial consideration. Bald eagles are protected under the Bald and Golden Eagle Protection Act (Eagle Act) and other Federal and state statutes. The word "disturb" under the Eagle Act was recently clarified, as well as the implementation of new regulations requiring permits to incidentally "take" eagles. Retrieve more information on management and life history at http://SWBEMC.org.

APPENDIX B

RATIONALE FOR EXCLUSION OF POTENTIALLY OCCURRING SPECIES FROM BA

Federally Listed Species

Lists of TECP species under the ESA that could occur in the counties within which the Project occurs were obtained from the USFWS and included Apache, Coconino and Navajo counties in Arizona and McKinley, Sandoval and San Juan counties in New Mexico (USFWS 2012, 2013c). The USFWS lists include a total of 39 TECP species that could occur within the 6 counties crossed by the Project or study area. These include 6 bird species, 5 mammal species, 4 reptile and amphibian species, 10 fish species, 2 invertebrate species, and 12 plant species.

Occurrence potential within the Action Area was evaluated for each of the 39 species based on the habitat requirements and/or known distribution. As a result, 30 of these species were eliminated from further analysis because there was no suitable habitat for the species within the Action Area (including existing transmission line ROWs), their known ranges are outside of the Action Area or in habitats adjacent to the Action Area where no potential disturbance activities would occur, or the species would only occur on rare occasions as a potential migrant through the Action Area (Appendix Table B-1). It was determined that for the 30 eliminated species no Project related adverse effects are likely to occur.

Appendix Table B-1 Evaluation of Need for Consultation for Species Identified as Potentially Occurring in Action Area by USFWS.

Species Scientific Name	Species Common Name	Status	Counties (AZ, NM)	Habitat Type	Eliminate from Further Analysis?
Mammals					
Canis lupus baileyi	Mexican gray wolf	Federally Endangered	Apache, Navajo	Chaparral, woodland, and forested areas.	**Yes.** Mexican gray wolf may occur as a rare migrant through the Action Area. It could potentially cross the APS transmission line ROWs, but would not occur elsewhere in the Action Area. Any limited potential habitat is too isolated to support this species. Additionally, this species would be able to easily avoid any activities relating to the Proposed Action occurring within the ROW, should they occur during such activities. Therefore there would be no effect on this species.
Cynomys gunnisoni	Gunnisons's prairie dog	Listing not warranted Nov 14, 2014 (78 FR 68660)	Sandoval	PNM identified 3 existing, but sparsely populated colonies along FW line. FW67-76, FW 89-106, FW608-611	Yes. Listing not warranted Nov 14, 2014 (78 FR 68660). Species not reported in IPaC, but was on original list sent to USFWS Nov 21, 2013 and confirmed by them.
Lynx canadensis	Canada lynx	Federal Candidate	San Juan	Subalpine/coniferous forests. Mature forests with downed logs and windfalls provide cover for denning, escape and protection from severe weather.	**Yes.** Lynx may occur as a rare migrant through the Action Area. It could potentially cross the APS transmission line ROWs, but would not occur elsewhere in the Action Area. Limited potential habitat in the Chuska mountains is too isolated to support this species. Additionally, this species would be able to easily avoid any activities relating to the Proposed Action occurring within the ROW, should they occur contemporaneously with the species passage through the area. Therefore there would be no effect on this species. Species not included on IPaC species list, but was on original list sent to USFWS Nov 21, 2013 and confirmed by them.

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Species Scientific Name	Species Common Name	Status	Counties (AZ, NM)	Habitat Type	Eliminate from Further Analysis?
Mustela nigripes	Black-footed ferret	Federally Endangered	Apache, Coconino, Navajo	Grassland plains/prairie. Prairie Dog town complexes of 200 acres or more for the Gunnison's prairie dog (*Cynomys gunnisoni*) and/or 80 acres or more for any subspecies of Black-tailed prairie dog (*Cynomys ludovicianus*). No known wild ferrets on the Navajo Nation except for those associated with the Arizona Game and Fish Dept. reintroduction on Tribal Ranch lands of Big Boquillas in Aubrey Valley, Coconino Co., approximately 100 miles to the west of the Action Area	**Yes**. Prairie dog (*Cynomys gunnisoni*) towns of marginally sufficient size exist to support black-footed ferret in the mine portion of the Action Area. However, no black-footed ferrets have been observed in New Mexico since 1934 and they were moved to the historically present list for San Juan County by NMDGF in 2004.
Zapus hudsonius luteus	New Mexico jumping mouse	Federal Proposed Endangered	Apache, Sandoval	Nests in dry soils but also uses moist, streamside, dense riparian/wetland vegetation. The jumping mouse appears to only utilize two riparian community types: (1) persistent emergent herbaceous wetlands; and (2) scrub-shrub wetlands. The New Mexican jumping mouse is diminished to 6 populations in the White Mountains, Arizona.	**Yes**. There is no suitable habitat for this species within the Action Area.
Birds					
Coccyzus americanus	Yellow-billed cuckoo	Federal Proposed Threatened	Apache, Coconino, Navajo, San Juan	Nesting cuckoos are associated with relatively dense, wooded, streamside riparian habitat, with varying combinations of Fremont cottonwood, willow, velvet ash, Arizona walnut, mesquite, and tamarisk. Some cuckoos also have been detected nesting in velvet mesquite, netleaf hackberry, Arizona sycamore, Arizona alder, and some exotic neighborhood shade trees.	**No**. Potential habitat could develop within the Action Area in riparian areas with higher canopies or salt cedar along the San Juan River. Habitat is currently limited to isolated patches of marginal habitat that do not support nesting.

Species Scientific Name	Species Common Name	Status	Counties (AZ, NM)	Habitat Type	Eliminate from Further Analysis?
Empidonax traillii extimus	Southwestern willow flycatcher	Federally Endangered	Apache, Coconino, Navajo, San Juan	Riparian-obligate bird found in cottonwood/willow and tamarisk vegetation communities along rivers and streams.	**No**. Marginal habitat that does not support nesting was identified within 30 km of the FCPP near Morgan Lake and along the San Juan River. Habitat could develop within some portions of the Action Area over the life of the project.
Gymnogyps californicus	California Condor	Federally Endangered; Experimental Population, Non-Essential	Apache, Coconino, Navajo,	High desert canyons and plateaus. Ill-defined nest, if any, composed of existing debris within overhung cliff ledges, crevices, potholes, or caves; in northern Arizona, nesting will likely be within walls of major river canyons or tall, steep cliffs within desert scrub and grasslands that allow easy approach from the air, and are inaccessible for terrestrial predators.	**No**. Suitable nesting habitat is not found within the Action Area and is very limited in adjacent areas. California condors could occur as occasional visitors within the Action Area or use the area for foraging.
Strix occidentalis lucida	Mexican spotted owl	Federally Threatened	Apache, Coconino, Navajo, San Juan	Nests in canyons and dense forests with multilayered foliage structure. Generally nest in older forests of mixed conifer or ponderosa pine/gambel oak type. Restricted habitat includes mixed-conifer forest, pine-oak forest, and riparian areas.	**No**. Suitable habitat is found within the Action Area. 34 acres of suitable habitat occurs in scattered patches adjacent to the ROWs.
Anthus spragueii	Sprague's pipet	Federal Candidate	San Juan	Breeds in northern Great Plains. Non breeding range extends from south-central and south-eastern AZ, occasionally in southern NM. Habitat during migration and in winter consists of pastures and weedy fields, including grasslands with dense herbaceous vegetation or grassy agricultural fields	**Yes.** The current range of this species is outside the Action Area.

Species Scientific Name	Species Common Name	Status	Counties (AZ, NM)	Habitat Type	Eliminate from Further Analysis?
Grus americana	Whooping crane	Experimental Population	McKinley, Sandoval, San Juan	Nesting occurs in Wood Buffalo National Park Canada, in poorly drained are with numerous potholes, dominated by bulrush. Wintering occurs at Aransas National Wildlife Refuge, TX, where whooping cranes utilize salt marshes and gently rolling sandy areas dominated by oak brush, grasslands, swales and ponds.. Experimental population attempted beginning in 1975 with nesting at Grays Lake National Wildlife Refuge, ID and overwinter habitat in NM. Population since extirpated.	**Yes**. Experimental population extirpated per BISON-M. Species not reported in IPaC, but was on original list sent to USFWS Nov 21, 2013 and confirmed by them.
Amphibians					
Lithobates chiricahuensis	Chiricahua leopard frog	Federally Threatened	Apache, Navajo, Coconino	Streams, rivers, backwaters, ponds, and stock tanks that are mostly free from introduced fish, crayfish, and bullfrogs.	**Yes**. The current range of this species is outside the Action Area.
Plethodon neomexicanus	Jemenz Mountains salamander	Federal Endangered	Sandoval	Generally found below ground, except where warm, wet conditions are present above ground (typically July through September). When above ground they are usually found under logs, rocks, or moss. Distribution restricted to the Jemez Mountains in northern New Mexico, in Los Alamos, Rio Arriba, and Sandoval Counties, around the rim of the collapsed caldera (large volcanic crater), with some occurrences on topographic features (e.g., resurgent domes) on the interior of the caldera.	**Yes**. The current range of this species is outside the Action Area.

Species Scientific Name	Species Common Name	Status	Counties (AZ, NM)	Habitat Type	Eliminate from Further Analysis?
Reptiles					
Thamnophis eques megalops	Northern Mexican Garter-snake	Federal Proposed Threatened	Apache, Navajo, Coconino	Cienegas, stock tanks, large-river riparian woodlands and forests, streamside gallery forests. Core population areas in the US include mid/upper Verde River drainage, mid/lower Tonto Creek, and the San Rafael Valley and surrounding area. Status on tribal lands unknown. Strongly associated with the presence of a native prey base including leopard frogs and native fish.	**Yes.** Suitable habitat is not found within the Action Area.
Thamnophis rufipunctatus	Narrow-headed Garter-snake	Federal Proposed	Apache, Navajo, Coconino	The narrow-headed garter snake is one of the most aquatic of the garter snakes. This species is strongly associated with clear, rocky streams using predominantly pool and riffle habitat that includes cobbles and boulders, but it has also been observed using lake shoreline habitat in New Mexico. The species occurs at elevations from 2,300 – 8,200-feet in four types of biotic communities: Petran Montane Conifer Forest, Great Basin Conifer Woodland, Interior Chaparral, and the Arizona Upland subdivision of Sonoran Desert scrub.	**Yes.** Suitable habitat is not found within the Action Area.
Fish					
Catostomus discorbolus yarrow	Zuni bluehead sucker	Federal Proposed Endangered	Apache	Small streams in low velocity, moderate deep pools, and pool runs with seasonal dense algae. Young prefer quieter shallow areas near shoreline. Limited to possibly one creek in Arizona and to the headwaters of Zuni River drainage in New Mexico.	**Yes.** The current range of this species is outside the Action Area.

Species Scientific Name	Species Common Name	Status	Counties (AZ, NM)	Habitat Type	Eliminate from Further Analysis?
Gila cypha	Humpback chub	Federally Endangered	Coconino	Large, warm turbid rivers especially canyon areas with deep fast water. Species found in the Upper Colorado River basin in Utah and Colorado, and in the Little Colorado and Colorado rivers in Marble and Grand canyons, Arizona.	**Yes.** Suitable habitat is not found within the Action Area.
Gila robusta	Roundtail chub	Federal Candidate, Lower Colorado River Basin DPS	Apache, Coconino, Navajo	Cool to warm waters of rivers and streams, and often occupy the deepest pools and eddies of large streams. Spawning occurs from February through June in pool, run, and riffle habitats, with slow to moderate water velocities	**Yes**. The current range of this species is outside the Action Area.
Lepidomeda vittata	Little Colorado spinedace	Federally Threatened	Apache, Coconino, Navajo	Moderate to small streams; found in pools and riffles with water flowing over fine gravel and silt substrate.	**Yes.** The current range of this species is outside the Action Area.
Oncorhynchus gilae apache	Apache trout	Federally Threatened	Apache, Coconino,	This species is presently restricted to drainages in the White Mountains. Habitat includes streams and rivers generally above 6,000-foot elevation with adequate stream flow and shading; temperatures below 77°F; and substrate composed of boulders, rocks, gravel and some sand and silt.	**Yes.** The current range of this species is outside the Action Area.

Species Scientific Name	Species Common Name	Status	Counties (AZ, NM)	Habitat Type	Eliminate from Further Analysis?
Ptychocheilus lucius	Colorado pike-minnow	Federally Endangered; Experimental Population, Non-Essential	San Juan	On the Navajo Nation, it has been documented throughout the San Juan River (SJR), from Shiprock to Lake Powell; the mouth of the Mancos River is used during the spring runoff period. The majority of adults use the stretch from about 11 km downstream of Shiprock (RM 142) to just downstream of Four Corners (RM 117), and spawn in 'The Mixer Area' (RM 131-132); young-of-year have primarily been found within the lower 26 km of the SJR just upstream of Lake Powell. Adults use backwaters and flooded riparian areas during spring runoff, and migrate large distances (15 to 64 km in the SJR) to spawn in riffle run areas with cobble/gravel substrates. Post-spawning adults primarily use run habitats, with eddies and slackwater also being important. Young-of-year (<120-mm length) use warm backwaters along shorelines. Deeper backwater areas (>1 m deep at confluence with main channel) are the preferred habitat of young fish into the subadult stage (>3 yrs. age and 200- to 400-mm length). Irrigation canals and ponds connected to SJR may be potential habitat.	**No.** This species is known to occur in the San Juan River.
Tiaroga cobitis	Loach minnow	Federally Endangered	Apache, Navajo	Presently found in small to large perennial streams with swift shallow water over cobble and gravel. Recurrent flooding and natural hydrograph important.	**Yes.** The current range of this species is outside the Action Area.

Species Scientific Name	Species Common Name	Status	Counties (AZ, NM)	Habitat Type	Eliminate from Further Analysis?
Xyrauchen texanus	Razorback sucker	Federally Endangered	Coconino; San Juan	This species is restricted to the Colorado River and a few of its warm-water tributaries; rare along the mainstem Colorado River in Marble Canyon and the mouth of the Little Colorado River, San Juan arm of Lake Powell, and upstream within the SJR. In mainstream portions of rivers, pre- and post-spawning suckers mostly use low-flow areas (backwaters over sand and silt substrate, deep eddies, and impoundments), but shallow to deep runs over sandbars and seasonally flooded shorelines also are important. Spawning occurs in areas with shallow, swift riffles over gravel or cobble substrate, and they also may use backwater habitats. Young-of-year use warm, flooded bottomlands and backwaters. Irrigation canals and ponds connected to the SJR may be potential habitat.	**No.** This species is known to occur in the San Juan River.
Oncorhynchus clarki virginalis	Rio Grande cutthroat trout	Federal Candidate	Sandoval	Small, swift-running, cold streams of the Rio Grande, Chama, Jemez and Rio San Jose drainages.	**Yes.** The current range of this species is outside the Action Area
Hybognathus amarus	Silvery minnow	Federally Endangered	Sandoval	Uses silt substrates in areas of low or moderate water velocity (e.g., eddies formed by debris piles, pools, and backwaters) and shallow depths, typically less than 16 inches (40 cm). Current distribution occurs on the Rio Grande from Cochiti Dam to the headwaters of Elephant Butte Reservoir.	**Yes.** The current range of this species is outside the Action Area.

Species Scientific Name	Species Common Name	Status	Counties (AZ, NM)	Habitat Type	Eliminate from Further Analysis?
Invertebrates					
Oxyloma haydeni kanabensis	Kanab ambersnail	Federally Endangered	Coconino	Extremely geographically isolated. Three historical populations; two remaining; one on private property in Utah and one in Grand Canyon National Park. Associated with travertine seeps and springs, watercress, monkey flower, and other wetland vegetation.	**Yes.** The known range is outside Action Area.
Pyrgulopsis trivialis	Three Forks springsnail	Endangered	Apache	Rheocrene springs, seeps, marshes, spring pools, outflows and diverse lotic waters commonly referred to as cienegas. Distribution limited to Three Forks and Boneyard Spring complexes in the North Fork of the East Fork Black River watershed.	**Yes.** The known range is outside of the Action Area.
Plants					
Asclepias welshii	Welsh's milkweed	Federally Threatened	Apache, Coconino, Navajo	Open, sparsely vegetated semistabilized sand dunes and on lee slopes of actively drifting sand dunes.	**Yes.** Known range outside the Action Area.
Astragalus cremnophylax var. *cremnophylax*	Sentry milk-vetch	Federally Endangered	Coconino	Grows on a white layer of Kaibab limestone, with little or no soil, in an unshaded opening within a pinyon-juniper-cliffrose plant community.	**Yes.** Known range outside Action Area.

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Species Scientific Name	Species Common Name	Status	Counties (AZ, NM)	Habitat Type	Eliminate from Further Analysis?
Astragalus humillimus	Mancos milk-vetch	Federally Endangered	San Juan	Forms highly localized populations from 4 to 20 acres in size. It is typically found on large, nearly flat sheets of exfoliating whitish-tan colored sandstone, in small depressions and sand-filled cracks on or near ledges and mesa tops in slickrock communities of Point Lookout & Cliffhouse Sandstone. Known only from the Four Corners area of New Mexico, San Juan County, and adjacent Montezuma County, Colorado. Navajo Nation Distribution: San Juan County, New Mexico, Palmer Mesa east to the Hogback area and south of the SJR, to a hogback east of Little Water. Potential Navajo Nation Distribution: Four Corners area, all slickrock formations of Point Lookout & Cliffhouse Sandstone, and possibly other related members.	**No.** Suitable habitat is present in the Action Area.
Carex specuicola	Navajo sedge	Federally Threatened	Apache, Coconino, Navajo	Silty soils at shady seeps and springs. Typically found in seeps and hanging gardens, on vertical sandstone cliffs and alcoves. General Distribution: Northern Arizona, San Juan Co, Utah. Navajo Nation Distribution: From the Navajo Creek drainage in Coconino Co, east to the Tsegi Canyon Watershed in Navajo Co, south to the Rock Point/Mexican Water & Canyon de Chelly National Monument, Apache Co, Arizona area. Potential Navajo Nation Distribution: Northern Arizona and southeastern Utah, especially in hanging gardens of the SJR drainage and Lake Powell.	**Yes.** A small amount of suitable habitat (59 acres) is found within the Action Area. However, the habitat is completely inaccessible by foot or vehicle traffic. No maintenance work will be conducted within the suitable habitat."

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Species Scientific Name	Species Common Name	Status	Counties (AZ, NM)	Habitat Type	Eliminate from Further Analysis?
Erigeron rhizomatus	Zuni fleabane	Federally Threatened	Apache; San Juan	Typically, only found on fine textured clay hillsides. It is known from clays derived from the Chinle Formation in the Zuni and Chuska Mountains, and to similar clays of the Baca Formation in the Datil and Sawtooth ranges in New Mexico. Only one known Arizona location in the Chuska Mountain on the Navajo Nation. Potential Navajo Nation Distribution: Chuska Mountains and in suitable habitat in the pinion-juniper associations between Lupton, Apache Co., Arizona, and Prewitt, McKinley Co., New Mexico.	**Yes.** Twelve acres of suitable habitat was observed in the Action Area, but no plants were found. BMPs would result in no effect on species from transmission line inspection or maintenance.
Packera franciscana	San Francisco Peaks groundsel	Federally Threatened	Coconino	Alpine tundra Found above spruce-fir and pine forests.	**Yes.** Known range outside Action Area.
Pediocactus bradyi	Brady pincushion cactus	Federally Endangered	Coconino	Benches and terraces in Navajo desert near Marble Gorge. Plant community dominated by shadescale (*Atriplex confertifolia*), snakeweed (*Gutierrezia sarothrae*), mormon tea (*Ephedra viridis*), and desert trumpet (*Eriogonum inflatum*).	**Yes.** This species was not included on NNHP data response as potentially occurring within the Action Area.
Pediocactus knowltonii	Knowlton's cactus	Federally Endangered	San Juan	Rolling, gravelly hills covered with pinyon pine, Rocky Mountain juniper, and sagebrush. Knowlton cactus is found on the very eastern edge of the Colorado Plateau Province, adjacent to the San Juan Mountains. Grows on tertiary alluvial deposits overlying the San Jose Formation. Known populations range from 2,075- to 2,300-meter elevation. The only viable populations exist in San Juan County, New Mexico.	**Yes.** The known range is outside the Action Area.

Species Scientific Name	Species Common Name	Status	Counties (AZ, NM)	Habitat Type	Eliminate from Further Analysis?
Pediocactus peeblesianus var. *fickeiseniae*	Fickeisen plains cactus	Federally Endangered	Coconino	Soils overlain by Kaibab Limestone in Navajoan desert or Great Plains Grassland, along canyon rims and flat terraces along washes, typically with limestone chips scattered across the surface. General Distribution: Arizona: Coconino Co., from House Rock Valley and Gray Mt., to the Little Colorado and Colorado rivers. Navajo Nation Distribution: Gray Mountain to southwest of Bitter Springs, Coconino Co., Arizona Potential Navajo Nation Distribution: Marble Canyon to Gray Mountain.	**No.** Eleven acres of low to moderate quality habitat was identified along the FCPP to Moenkopi ROW in Coconino Co., AZ. Focus surveys in 2013 did not find any individuals within these areas.
Pediocactus peeblesianus var. *peeblesianus*	Peebles Navajo cactus	Federally Endangered	Navajo	Gravely soils of the Shinarump conglomerate of the Chinle Formation.	**Yes.** Known range outside the Action Area.
Pediocactus sileril	Siler pincushion cactus	Federally Threatened	Coconino	Desert-scrub transitional areas of Navajo, sagebrush and Mohave Deserts.	**Yes.** Known range outside the Action Area.
Sclerocactus mesae-verdae	Mesa Verde cactus	Federally Threatened	San Juan	Salt-desert scrub communities, typically in the Fruitland and Mancos shale formations, but also in the Menefee Formation overlaying Mancos shale. It is most frequently found on the tops of hills or benches and along slopes. General Distribution: San Juan Co, New Mexico, and adjacent Montezuma Co, Colorado. Navajo Nation Distribution: Colorado border south to near Naschitti, New Mexico. Potential Navajo Nation Distribution: Within the known distribution to the north, south, and west. The eastern limits are still unclear.	**No.** Known to occur within Action Area along PNM FCCP to San Juan transmission line. Potentially suitable habitat also present along portions of the APS ROWs and in the DFADA.

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FCPP and Navajo Mine Energy Project
Biological Assessment

APPENDIX C

MODELED SUITABLE HABITAT FOR LISTED SPECIES

Appendix C was too large to be distributed electronically. This appendix includes the AECOM Habitat Modeling Report maps showing the distribution of suitable habitat for the species included in the BA. This information can be accessed using the following credentials at https://ftp.entrix.com:

Username: fcpp_lw

Password: pikeminnow

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